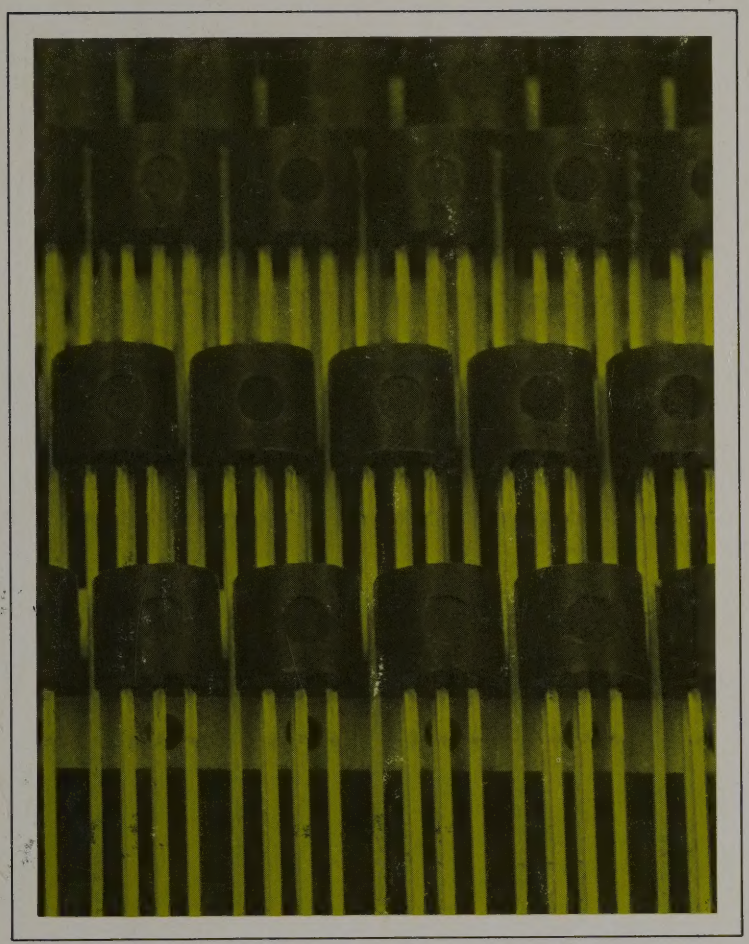
FAIRCHILD SEMICONDUCTOR



TO-92 Plastic Transistors

March 1971

LIMA TECHNICAL COLLEGE
OSU LIMA CAMPUS
4240 Campus Drive
LIMA, OHIO 45804

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INTRODUCTION

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There is much more to a TO-92 package than the physical outlines specified by its JEDEC registration. The internal structure, hidden by the encapsulant, the package materials themselves and the methods used in assembling chip and package determine the package's ultimate quality and usefulness.

At Fairchild we believe the long-term reliability of our TO-92 design makes it superior to any other TO-92 currently available in terms of moisture resistance, stability under internal and external temperature stresses and in resistance to physical damage on the user's assembly line. X-ray photographs of Fairchild's TO-92 (Figure 1.) and two competitive designs support this belief.

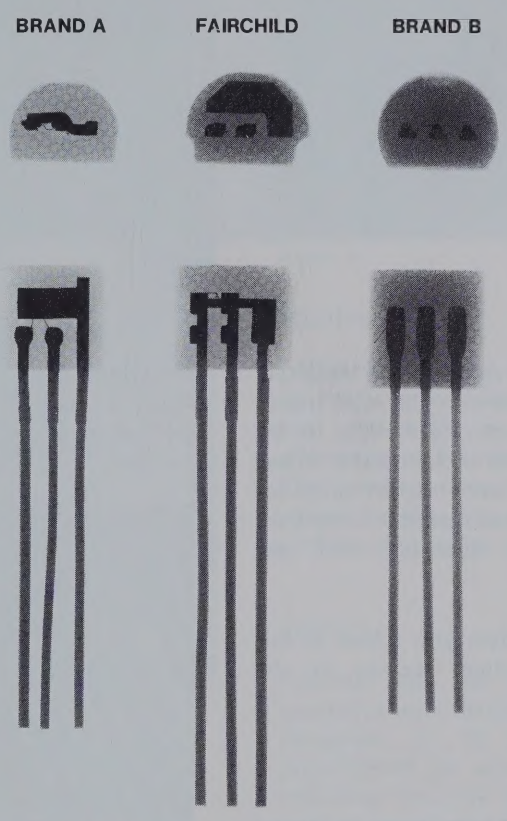


Figure 1

The most apparent advantage of Fairchild's TO-92 is that the leads are positively double-locked into the encapsulant, making the structure inherently less subject to intermittent opens and shorts caused by vibration or thermal stress. Leads of the type shown in packages A and B have been known to literally fall out of the package or to vibrate sufficiently to break the wire bonds between the leads and the transistor chip under the thermal and vibrational stresses of mechanical soldering operations in which the plastic encapsulant and the metal lead materials expand differentially.

The fact that the collector pad is placed perpendicular to the lead plane minimizes the amount of metal in the natural parting plane of the package. The greater plastic-to-plastic interface in the Fairchild TO-92 makes the package body stronger than the others.

Another significant advantage of the Fairchild TO-92 is the lead material itself — combined with a special silicone molding compound. Leads are of a special copper alloy with low thermal resistance. Use of this material allows the package to dissipate 625 milliwatts of power in free air, compared with about 200 to 360 milliwatts for most other TO-92 designs. Thus, Fairchild's EIA registered TO-92-packaged devices, while rated at only 200 - 360 milliwatts per EIA specifications, are inherently capable of much higher dissipation. This capability also permits the use of TO-92 packages in sockets that previously required more expensive plastic power devices. The special silicone molding compound permits operation to 150°C. Combined with the benefits of the low thermal resistance lead frame, this feature allows device operation at elevated temperature power ratings previously restricted to only a few device types. The lower thermal resistance of the lead frame also increases reliability by decreasing operating temperatures at any given power rating.

Next, note that the chip location in the Fairchild package provides greater protection against moisture damage. In all plastic packages, the path that potentially damaging moisture is most likely to take is along the leads and up to the chip. This path is short and direct in package B. In package A it is somewhat longer, but still in a single plane. In the Fairchild package, the chip is at the far end of a platform positioned at right angles to the lead plane. Thus, in this package the path is not only the longest, but also is interrupted by a 90° change in planes, which inhibits the progress of moisture along the lead.

The unique configuration of the Fairchild collector pad (perpendicular to the plane of the base and emitter leads) also permits top-post bonding to provide increased bond strength and buries the bonding wires deeper in the package body away from vibrational stress. Gold ball thermocompression bonding avoids the potential for "necking down" and subsequent stress points at the heel of the bond associated with wedge bonding techniques. Thus the Fairchild package substantially decreases opens caused by bond fatigue.

Other advantages of the Fairchild TO-92 package include more consistent manufacturing and more extensive testing capabilities of the manufacturer. Fairchild's TO-92 production line is the most highly mechanized plastic transistor manufacturing line in the industry, assuring less product variation. Fairchild's computerized TO-92 test facilities provide 12 programmable modules, each capable of performing tests for 300 conditions. This gives Fairchild the ability to select product based on as many as 3600 tests.

The Fairchild TO-92 also is supplied with minimum lead length of 600 mils, which reduces tie-down restrictions to offer greater flexibility in board layout.

Add it up. The Fairchild TO-92 provides higher power dissipation capability, can be used in more sockets at higher temperature ratings, is more reliable because of better mechanical strength in leads and wire bonds, and is more uniform and more thoroughly tested than any other TO-92 design.

We believe it's the best in the industry.

Fairchild TO-92 Assembly

This is Fairchild's TO-92 Production Area located in Mountain View, California. This manufacturing area is the most highly mechanized plastic transistor manufacturing facility in the world. From the time that a scribed and broken wafer arrives at the front of the line until tested and marked units are bagged and ready for shipment, only three operator actions are required. The highly sophisticated assembly and test equipment handles the rest.

The following series of photographs gives you a look at this most advanced mechanized production facility in the semiconductor industry today.

Die Attach

This die attach equipment (see figure 2.) developed jointly by Fairchild and K & S permits die attach at rates an order of magnitude higher than can be achieved with conventional die attach techniques. The operator visually chooses a good die, squeezes the trigger and the die attach is made. The lead frame is then automatically stepped to the next position.

Figure 2

Magazines shown on both sides of the microscope (and in figure 3.) hold ten 50-unit copper alloy lead frames. The units are carried in these magazines from die attach until they are molded.

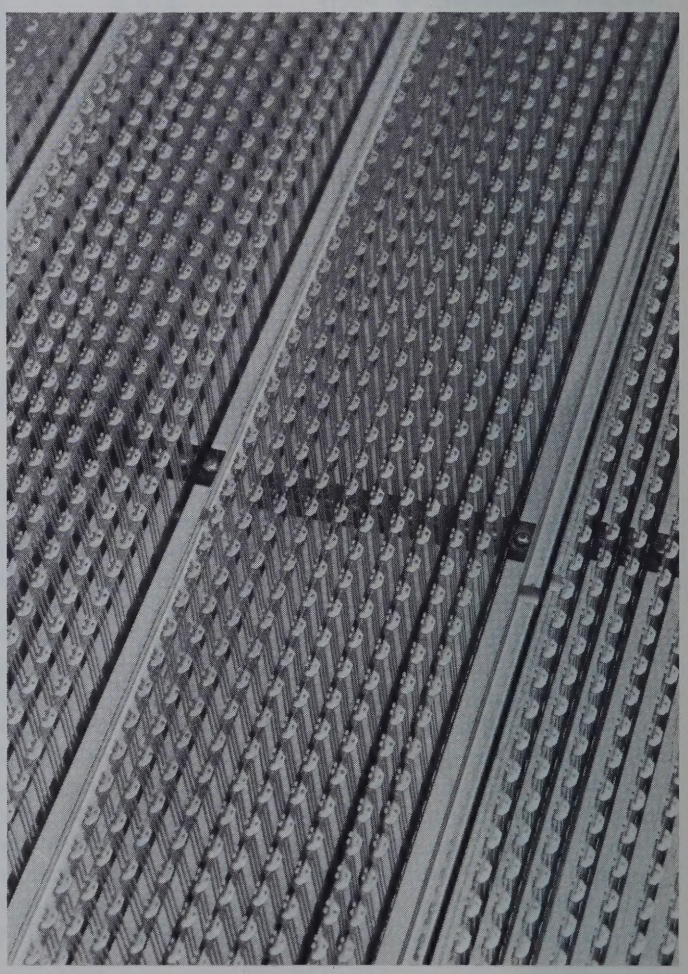


Figure 3

Lead Bonding

Since die attach is a single step operation it can be performed at a rate five times faster than lead bonding. Consequently, each production line consists of one die attach station followed by five lead bond stations as illustrated in figure 4. The only operator activity involves locating the bonding pad on the die itself. The thermocompression gold ball bond is made automatically after the squeeze of the trigger and the post bond is made automatically. The excess gold tail is removed and the hydrogen torch forms a new ball on the end of the wire for the next bond. The lead frame steps every other bond.

Figure 4

Wash, Bake

Following lead bonding, the units are processed through a controlled wash station where they are washed in hot deionized water and isopropyl alcohol. Drying is accomplished in a nitrogen environment as shown in figure 5. Units are then subjected to a stabilization bake.

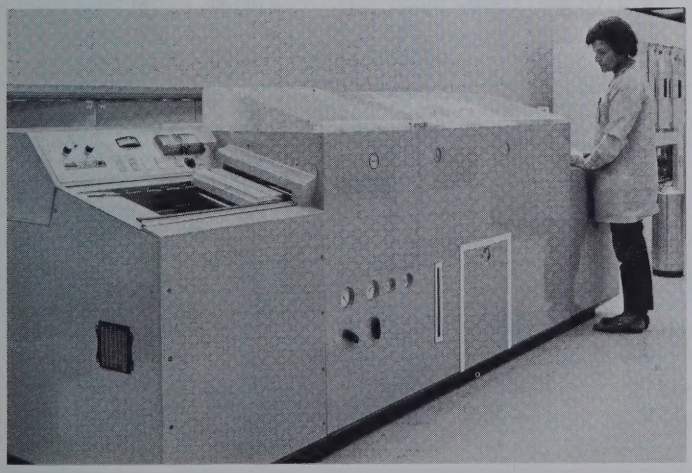


Figure 5

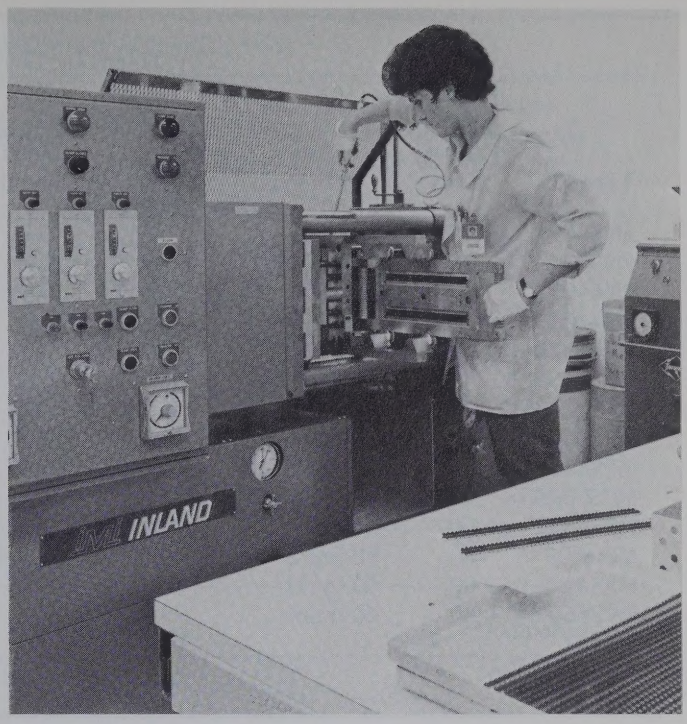


Figure 6

Molding

Following a second bake to cure the junction coat, the units are ready for molding. The units are transfer molded in a 200 ton press built for Fairchild by Inland Manufacturing, a subsidiary of Fairchild Camera and Instrument Corporation. The molding compound used is a specially selected silicone chosen for its purity, high temperature proprieties and the ease with which it molds. (As shown in figure 6.)

Testing

Fairchild has the most sophisticated semiconductor test capability ever available. The tester shown in figure 7 is comprised of 12 test modules, each capable of being programmed to simultaneously perform up to 300 tests including not only conventional DC testing, but AC testing such as capacitance, f_T and switching time as well. The tested units are then ejected into one of 32 sort bins as determined by the priorities set with the computer.

Following a verification of the testing by Quality Assurance, the units are marked and packed for shipment.

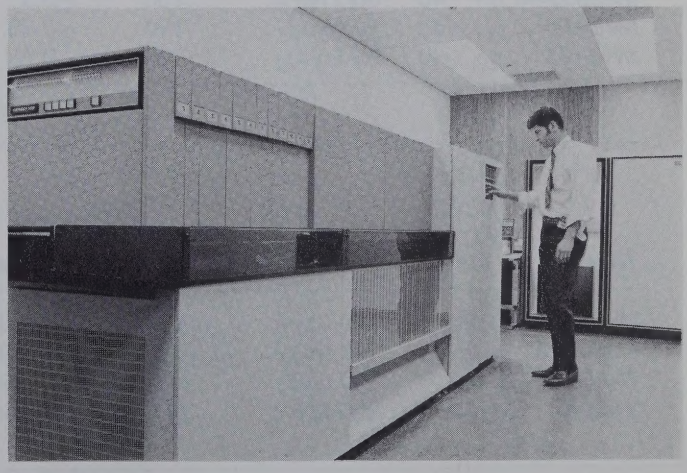


Figure 7

SELECTION GUIDES

NPN GENERAL PURPOSE AMPLIFIERS AND SWITCHES

Type	Rated V_{CEO} (V_{CER}) Volts	h_{FE} (min-max)	@ I_C mA	$V_{CE(sat)}$ Volts (max)	C_{obo} pF (max)	f_T MHz (min)	Power Dissipation $T_A = 25°C$ mW	Power Dissipation $T_C = 25°C$ W	t_{off} ns (max)
2N3903	40	50-150	10	0.2	4.0	250	310		225
2N3904	40	100-300	10	0.2	4.0	300	310		225
2N4400	40	50-150	150	0.4	6.5	200	310		255
2N4401	40	100-300	150	0.4	6.5	250	310		255
MPS6530	40	40-120	100	0.5	5.0	390 (typ)	625	1.0	
MPS6531	40	90-270	100	0.3	5.0	390 (typ)	625	1.0	
MPSA10	40	40-400	5.0		4.0	50	625	1.0	
MPSA20	40	40-400	5.0	0.25	4.0	125	625	1.0	
MPS6565	45	40-160	10	0.4	3.5	200	625	1.0	
MPS6566	45	100-400	20	0.4	3.5	200	625	1.0	
MPS6590	50	40 (min)	10	0.6	12		625	1.0	
MPSA05	60	50 (min)	100	0.25		50	625	1.0	
MPSA06	80	50 (min)	100	0.25		50	625	1.0	
MPS6591	80	40 (min)	10	0.6	12		625	1.0	

PNP GENERAL PURPOSE AMPLIFIERS AND SWITCHES

Type	Rated V_{CEO} (V_{CER}) Volts	h_{FE} (min-max)	@ I_C mA	$V_{CE(sat)}$ Volts (max)	C_{obo} pF (max)	f_T MHz (min)	Power Dissipation $T_A = 25°C$ mW	Power Dissipation $T_C = 25°C$ W	t_{off} ns (max)
2N5221	15	30-600	50	0.5	15	100	310		
MPS6563	20	50-200	350	0.5	30	60	625	1.0	
2N4126	25	120-360	2.0	0.4	4.5	250	310		155 (typ)
MPS6519	25	250-500	2.0	0.5	4.0	340 (typ)	625	1.0	
2N5226	25	30-600	50	0.8	20	50	310		
MPS3702	25	60-300	50	0.25	12	100	625	1.0	
MPS3703	30	30-150	50	0.25	12	100	625	1.0	
MPS6562	25	50-200	500	0.5	30	60	625	1.0	
MPS6535M	30	30 (min)	100	0.5	8.0	260 (typ)	625	1.0	
2N5227	30	50-700	2.0	0.4	5.0	100	310		
2N4125	30	50-150	2.0	0.4	4.5	200	310		155 (typ)
MPSA70	40	40-400	5.0	0.25	4.0	125	625	1.0	
2N3905	40	50-150	10	0.25	4.5	200	310		260
2N3906	40	100-300	10	0.25	4.5	250	310		300
2N4402	40	50-150	150	0.4	8.5	150	310		255
2N4403	40	100-300	150	0.4	8.5	200	310		255
MPS6516	40	50-100	2.0	0.5	4.0	200 (typ)	625	1.0	
MPS6517	40	90-180	2.0	0.5	4.0	200 (typ)	625	1.0	
MPS6518	40	150-300	2.0	0.5	4.0	340 (typ)	625	1.0	
MPS6533M	40	40-120	100	0.5	8.0	260 (typ)	625	1.0	
MPS6534M	40	90-270	100	0.3	8.0	260 (typ)	625	1.0	
MPSA55	60	50 (min)	100	0.25		50	625	1.0	
MPSA56	80	50 (min)	100	0.25		50	625	1.0	

PNP LOW LEVEL AMPLIFIERS

Type	Rated V_{CEO} (V_{CER}) Volts	h_{FE} (min-max)	@ I_C mA	h_{FE} (min-max)	@ I_C mA	NF dB (max)	@ f kHz	NF dB (max)	@ f kHz
MPS6522	25	100 (min)	0.1	200-400	2.0	3.0	Wideband		
MPS6523	25	150 (min)	0.1	300-600	2.0	3.0	Wideband		
2N5086	50	150-500	0.1	150 (min)	10	3.0	1.0	3.0	Wideband
2N5087	50	250-800	0.1	250 (min)	10	2.0	1.0	2.0	Wideband

SELECTION GUIDES

NPN HIGH SPEED SATURATED SWITCHES

Type	Rated V_{CEO} (V_{CER}) Volts	τ_S (t_{off}) ns (max)	@ I_C mA	h_{FE} (min-Max)	I_C mA	$V_{CE(sat)}$ Volts (max)	f_T MHz (min)	C_{obo} pF (max)	Power Dissipation $T_A = 25°C$ mW
2N4265	12	20	10	100-400	10	0.22	300	4.0	310
2N5224	12	60	10	40-400	10	0.35	250	4.0	310
2N4264	15	20	10	40-160	10	0.22	300	4.0	310
2N5772	15	18	10	30-120	30	0.2	350	5.0	625
2N5769	40	13	10	40-120	10	0.2	500(Min)	4.0	625
2N5845	40	(60)	500	25-150	500	0.6	200	9.0	500
2N5845A	40	(50)	500	35-150	500	0.5	250	9.0	500
MPS2713	18	(21)(typ)	10	30-120	2.0	0.3	250(typ)	2.5(typ)	500
MPS2714	18	(21)(typ)	10	80-300	2.0	0.3	250(typ)	2.5(typ)	500

PNP HIGH SPEED SATURATED SWITCHES

Type	Rated V_{CEO} (V_{CER}) Volts	τ_s (t_{off}) ns (max)	I_C mA	h_{FE} (min-max)	I_C mA	$V_{CE(sat)}$ Volts (max)	f_T MHz (min)	C_{obo} pF (max)	Power Dissipation $T_A = 25°C$ mW
MPSL07	6.0	15	10	30-120	10	0.15	500	3.0	625
MPSL08	12.0	20	10	30-120	10	0.15	700	3.0	625
2N5228	5.0	(140)	10	30 (min)	10	0.4	300	5.0	310
2N5771	15	20	10	50-120	10	0.15	850	3.0	625

NPN GENERAL PURPOSE AMPLIFIERS AND SWITCHES

Type	Rated V_{CEO} (V_{CER}) Volts	h_{FE} (min-max)	@ I_C mA	$V_{CE(sat)}$ Volts (max)	C_{obo} pF (max)	f_T MHz (min)	Power Dissipation $T_A = 25°C$ mW	Power Dissipation $T_C = 25°C$ W	t_{off} ns (max)
2N5219	15	35-500	2.0	0.4	4.0	150	310		
2N5220	15	30-600	50	0.5	10	310			
MPS2711	18	30-90	2.0		4.0		625	1.0	
MPS2712	18	75-225	2.0		4.0		625	1.0	
2N5223	20	50-800	2.0	0.7	4.0	150	310		
MPS6561	20	50-200	350	0.5	30	60	625	1.0	
MPS3706	20	30-600	50	1.0	12	100	625	1.0	
2N4124	25	120-360	2.0	0.3	4.0	300	310		136(typ)
2N5225	25	30-600	50	0.8	20	50	310		
MPS6514	25	150-300	2.0	0.5	3.5	390(typ)	625	1.0	
MPS6515	25	250-500	2.0	0.5	3.5	390(typ)	625	1.0	
MPS6560	25	50-200	500	0.5	30	60	625	1.0	
MPS2923	25	90-180(1 kHz)	2.0		12		625	1.0	
MPS2924	25	150-300(1 kHz)	2.0		12		625	1.0	
MPS2925	25	235-470(1 kHz)	2.0		12		625	1.0	
MPS2926	25	35-470(1 kHz)	2.0		3.5		625	1.0	
MPS3721	25	60-660(1 kHz)	2.0		3.5		625	1.0	
MPS3392	25	150-300	2.0		3.5		625	1.0	
MPS3393	25	90-180	2.0		3.5		625	1.0	
MPS3394	25	55-110	2.0		3.5		625	1.0	
MPS3395	25	150-500	2.0		3.5		625	1.0	
MPS5172	25	100-500	10	0.25	12	120(typ)	625	1.0	
2N4123	30	50-150	2.0	0.3	4.0	250	310		136(typ)
MPS6512	30	50-100	2.0	0.5	3.5	250(typ)	625	1.0	
MPS6513	30	90-180	2.0	0.5	3.5	150(typ)	625	1.0	
MPS6532	30	30 (min)	100	0.5	5.0	390(typ)	625	1.0	
MPS3704	30	100-300	50	0.6	12	100	625	1.0	
MPS3705	30	50-150	50	0.8	12	100	625	1.0	

SELECTION GUIDES

NPN LOW LEVEL AMPLIFIERS

Type	Rated V_{CEO} (V_{CER}) Volts	h_{FE} (min-max)	@ I_C mA	h_{FE} (min-max)	@ I_C mA	NF dB (max)	@ f kHz	NF dB (max)	@ f kHz
2N5961	30	100 (min)	.01	150-700	10	3.0	3.0	1.0	Wideband
2N5962	45	450 (min)	.01	600-1400	10	3.0	3.0	1.0	Wideband
2N5963	60	900 (min)	.01	1200-2200	10	3.0	3.0	1.0	Wideband
MPS6520	25	100 (min)	0.1	200-400	2.0			3.0	Wideband
2N5209	(50)	100-300	0.1	150 (min)	10	3.0	4.0	1.0	Wideband
MPS3707	30	100-400	0.1					5.0	Wideband
MPSA09	50	100-600	0.1			1.4(typ)	1.0		
MPS6521	25	150(min)	0.1	300-600	2.0			3.0	Wideband
2N5210	(50)	200-600	0.1	250 (min)	10	2.0	3.0	1.0	Wideband
MPS6571	20	250-1000	0.1			1.2(typ)	0.1		
2N5088	30	300-900	0.1	300 (min)	10			3.0	Wideband
2N5089	25	400-1200	0.1	400 (min)	10			2.0	Wideband
MPS3709	30	45-165	1.0						
MPS3708	30	45-660	1.0						
MPS3710	30	90-330	1.0						
MPS3711	30	180-660	1.0						

NPN HIGH VOLTAGE AMPLIFIERS

Type	Rated V_{CEO} Volts	h_{FE} (min-max)	@ I_C mA	I_C Range mA (useful)	f_T MHz (min)	C_{obo} pF (max)	Power Dissipation $T_A = 25°C$ mW
2N4409	50	60-400	1.0	0.01-50	60	12	310
2N4410	80	60-400	10	0.01-50	60	12	310
MPSL01	120	50-300	10	0.01-50	60	8.0	625
2N5550	160	60-250	10	0.01-50	100	6.0	310
MPS5551M	180	80-250	10	0.01-50	100	6.0	625

PNP HIGH VOLTAGE AMPLIFIERS

Type	Rated V_{CEO} Volts	h_{FE} (min-max)	@ I_C mA	I_C Range mA (useful)	f_T MHz (min)	C_{obo} pF (max)	Power Dissipation $T_A = 25°C$ mW
MPSL51	100	40-250	50	0.1-100	60	8.0	625
2N5400	120	40-180	10	0.1-100	100	6.0	310
2N5401	150	60-240	10	0.1-100	100	6.0	310

NPN RF-IF AMPLIFIERS AND OSCILLATORS

Type	Rated V_{CEO} Volts	f_T MHz (min)	C_{cb} pF (max)	P.G. (Osc. P_o) dB (mW) (min)	@ f MHz	NF dB (max)	@ f MHz	Power Dissipation $T_A = 25°C$ mW
MPS6511	20		2.5	30	45			625
PE5015	20	300	0.5	20	100	4.0	100	625
PE5010	30	.375	0.5	20	200	3.3	200	625
2N5770	15	900	1.7	30	500	6.0	60	625

SELECTION GUIDES

MONOLITHIC DARLINGTON AMPLIFIER TRANSISTORS

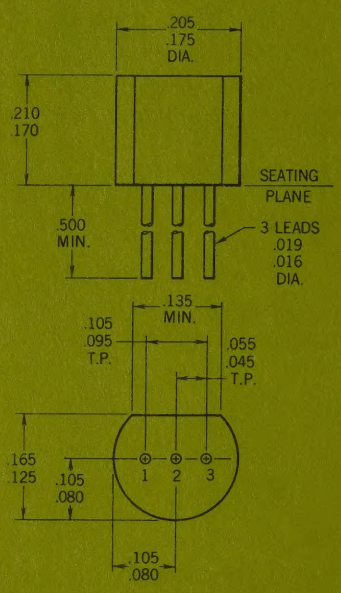
Type	Polarity	BV_{CEO} Volts (min)	f_T (MHz)	C_{ob} pF	h_{FE} I_C = 10 mA (min)	h_{FE} I_C = 100 mA (min)
MPSA12	NPN	20		8.0 (typ)	20,000	
MPSA13	NPN	30	125	2.0 (typ)	5,000	10,000
MPSA14	NPN	30	125	2.0 (typ)	10,000	20,000
MPSA65	PNP	30	100	2.5 (typ)	50,000	20,000
MPSA66	PNP	30	100	2.5 (typ)	75,000	40,000

MONOLITHIC DUAL DIODES

Type	Polarity	$V_{(RR)}$ (Volts)	I_R (nA) @ V_R (Volts)	I_F (mA) @ 1.0 V	Cap. (pF)
MSD6101	Common Cathode	50	0.1 @ 40	200	2.0
MSD6102	Common Cathode	70	0.1 @ 50	200	3.0
MSD6150	Common Anode	70	0.1 @ 50	200	3.5

PHYSICAL DIMENSIONS

in accordance with JEDEC (TO-92)



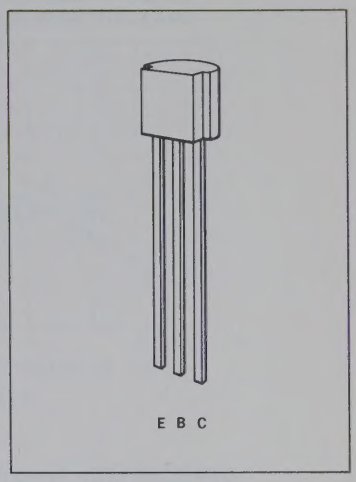
LEAD CONFIGURATION NOTATION	LEAD NUMBER 1	2	3
EBC	EMITTER	BASE	COLLECTOR
BEC	BASE	EMITTER	COLLECTOR
AAC	ANODE	ANODE	CATHODE
CCA	CATHODE	CATHODE	ANODE

2N3903 • 2N3904

NPN GENERAL PURPOSE AMPLIFIERS AND SWITCHES

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- MEDIUM VOLTAGE . . . V_{CEO} = 40 V (MIN)
- HIGH GAIN . . . . . h_{FE} = 100-300 AT 10 mA
- LOW NOISE . . . . . NF = 5.0 dB (MAX) WIDEBAND
- COMPLEMENTARY TO 2N3905 • 2N3906



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	-55° C to +135° C
†Operating Junction Temperature	+135° C
†Lead Temperature (Soldering, 60 secons time limit)	+230° C

Maximum Power Dissipation (Notes 2 and 3)

†Total Dissipation at 25° C Ambient Temperature	0.31 Watt
at 60° C Ambient Temperature	0.21 Watt

Maximum Voltages and Current

†V_{CBO}	Collector to Base Voltage	60 Volts
†V_{CEO}	Collector to Emitter Voltage (Note 4)	40 Volts
†V_{EBO}	Emitter to Base Voltage	6.0 Volts
†I_C	Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25° Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N3903 MIN.	2N3903 MAX.	2N3904 MIN.	2N3904 MAX.	UNITS	TEST CONDITIONS	
†h_{FE}	DC Pulse Current Gain (Note 5)	20		40			I_C = 0.1 mA,	V_{CE} = 1.0 V
†h_{FE}	DC Pulse Current Gain (Note 5)	35		70			I_C = 1.0 mA,	V_{CE} = 1.0 V
†h_{FE}	**DC Pulse Current Gain** (Note 5)	50	150	**100**	**300**		**I_C = 10 mA,**	**V_{CE} 1.0 V**
†h_{FE}	DC Pulse Current Gain (Note 5)	30		60			I_C = 50 mA,	V_{CE} = 1.0 V
†h_{FE}	DC Pulse Current Gain (Note 5)	15		30			I_C = 100 mA,	V_{CE} = 1.0 V
†$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.2		0.2	Volts	I_C = 10 mA,	I_B = 1.0 mA
†$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.3		0.3	Volts	I_C = 50 mA,	I_B = 5.0 mA
†$V_{BE(sat)}$	Base Saturation Voltage (Note 5)	0.65	0.85	0.65	0.85	Volts	I_C = 10 mA,	I_B = 1.0 mA
†$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.95		0.95	Volts	I_C = 50 mA,	I_B = 5.0 mA
†I_{CEX}	Collector Cutoff Current		50		50	nA	V_{CE} = 30 V,	V_{BE} = -3.0 V
†I_{BL}	Base Cutoff Current		50		50	nA	V_{CE} = 30 V,	V_{BE} = -3.0 V
†BV_{CBO}	Collector to Base Breakdown Voltage	60		60		Volts	I_C = 10 μA,	I_E = 0
†BV_{CEO}	**Collector to Emitter Breakdown Voltage** (Note 5)	**40**		**40**		**Volts**	**I_C = 1.0 mA**	**I_B = 0**
†BV_{EBO}	Base to Emitter Breakdown Voltage	6.0		6.0		Volts	I_C = 0,	I_E = 10 μA
†C_{obo}	Output Capacitance (f = 100 kHz)		4.0		4.0	pF	I_E = 0,	V_{CB} = 5.0 V
†C_{ibo}	Input Capacitance (f = 100 kHz)		8.0		8.0	pF	I_C = 0,	V_{EB} = 0.5 V
†h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.5		3.0			I_C = 10 mA,	V_{CE} = 20 V
†f_T	Current Gain Bandwidth Product (f = 100 MHz)	250		300		MHz	I_C = 10 mA,	V_{CE} = 20 V
†t_d	Delay time (See Figure 1)		35		35	ns	$I_C \approx$ 10 mA,	$I_{B1} \approx$ 1.0 mA
†t_r	Rise Time (See Figure 1)		35		35	ns	$I_C \approx$ 10 mA,	$I_{B1} \approx$ 1.0 mA
†t_s	Storage Time (See Figure 2)		175		200	ns	$I_C \approx$ 10 mA, $I_{B2} \approx$ 1.0 mA	$I_{B1} \approx$ 1.0 mA
†t_f	Fall Time (See Figure 2)		50		50	ns	$I_C \approx$ 10 mA, $I_{B2} \approx$ -1.0 mA	$I_{B1} \approx$ 1.0 mA
†h_{ie}	Input Impedance (f = 1.0 kHz)	0.5	8.0	1.0	10	kΩ	I_C = 1.0 mA,	V_{CE} = 10 V
†h_{re}	Voltage Feedback Ration (f = 1.0 kHz)	0.1	5.0	0.5	8.0	$X10^{-4}$	I_C = 1.0 mA,	V_{CE} = 10 V
†h_{fe}	Small Signal Current Gain f = 1.0 kHz)	50	200	100	400		I_C = 1.0 mA,	V_{CE} = 10 V
†h_{oe}	Output Admittance (f = 1.0 kHz)	1.0	40	1.0	40	μmho	I_C = 1.0 mA,	V_{CE} = 10 V
†NF	**Noise Figure (f = 10 Hz to 15.7 kHz)**		**6.0**		**5.0**	**dB**	**I_C = 100 μA, R_S = 1.0 kΩ**	**V_{CE} = 5.0 V**

†JEDEC Registered Values

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 135° C and junction to ambient thermal resistance of 357° C/Watt (derating factor of 2.81 mW/° C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse conditions length = 300 μs; duty cycle = 2%.

FIGURE 1–DELAY AND RISE TIME EQUIVALENT TEST CIRCUIT

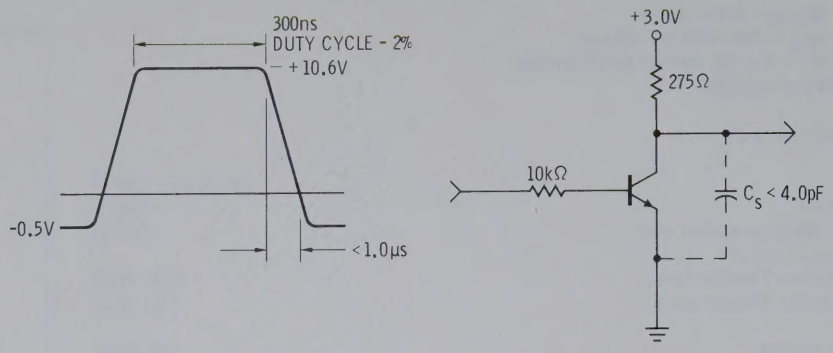
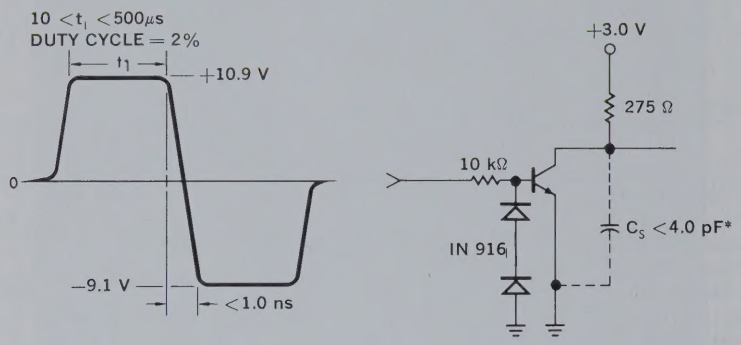


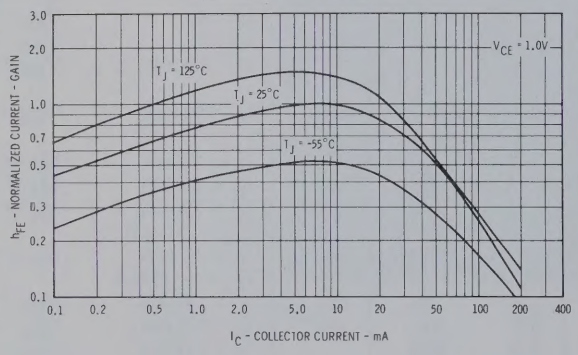
FIGURE 2–STORAGE AND FALL TIME EQUIVALENT TEST CIRCUIT



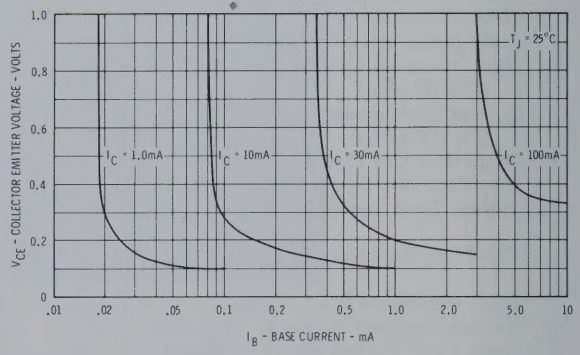
*Total shunt capacitance of test jig and connectors

TYPICAL ELECTRICAL CHARACTERISTICS

NORMALIZED DC CURRENT GAIN VERSUS COLLECTOR CURRENT

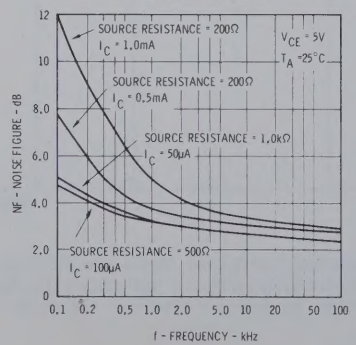


COLLECTOR TO EMITTER VOLTAGE VERSUS BASE CURRENT

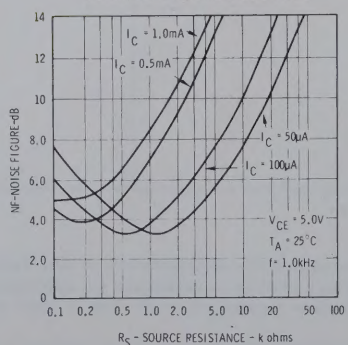


NOISE FIGURE VARIATIONS V_{CE} = 5.0 V, T_A = 25°C

NOISE FIGURE VERSUS FREQUENCY

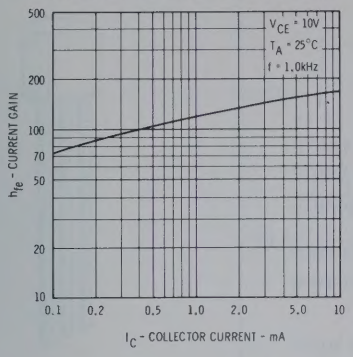


NOISE FIGURE VERSUS SOURCE RESISTANCE

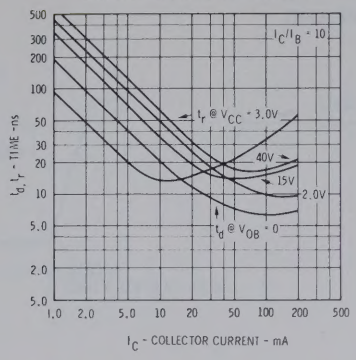


TYPICAL ELECTRICAL CHARACTERISTICS

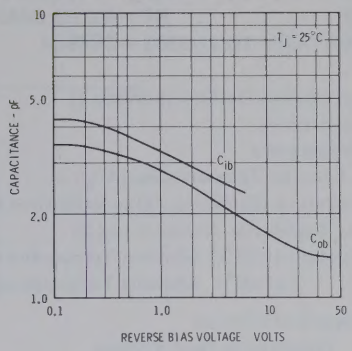
SMALL SIGNAL CURRENT GAIN VERSUS COLLECTOR CURRENT



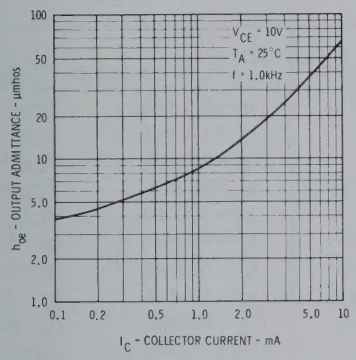
TURN ON TIME VERSUS COLLECTOR CURRENT



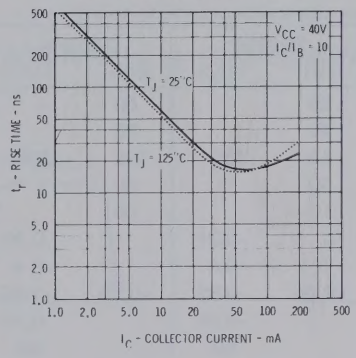
CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



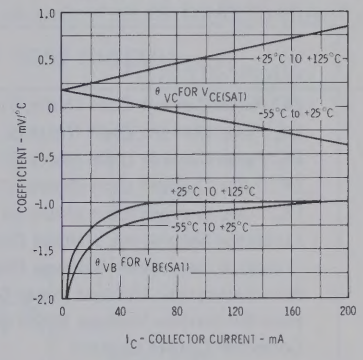
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT



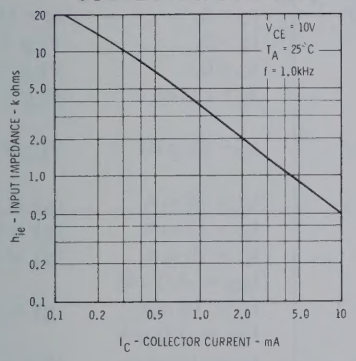
RISE TIME VERSUS COLLECTOR CURRENT



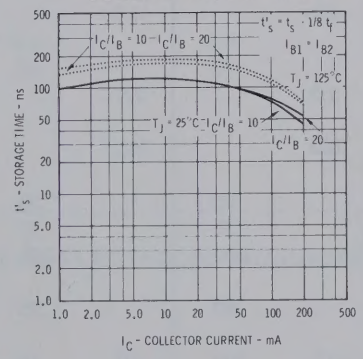
TEMPERATURE COEFFICIENTS VERSUS COLLECTOR CURRENT



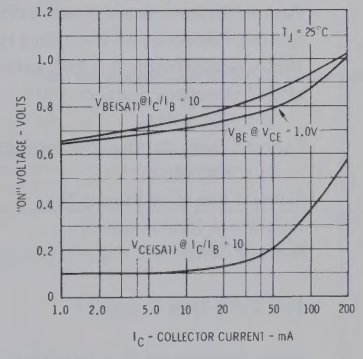
INPUT IMPEDANCE VERSUS COLLECTOR CURRENT



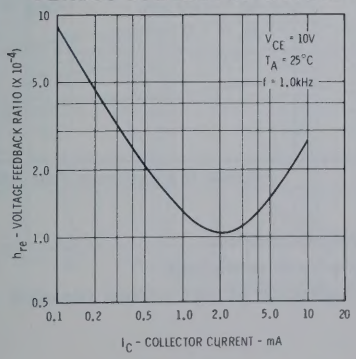
STORAGE TIME VERSUS COLLECTOR CURRENT



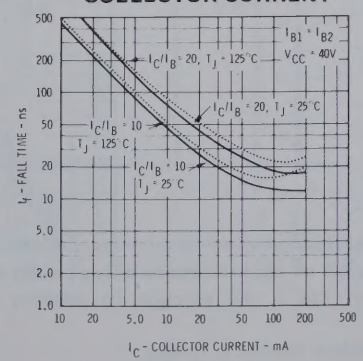
"ON" VOLTAGE VERSUS COLLECTOR CURRENT



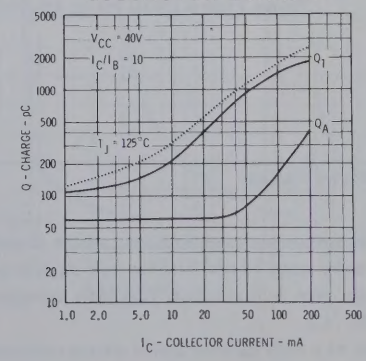
VOLTAGE FEEDBACK RATIO VERSUS COLLECTOR CURRENT



FALL TIME VERSUS COLLECTOR CURRENT



CHARGE DATA VERSUS COLLECTOR CURRENT

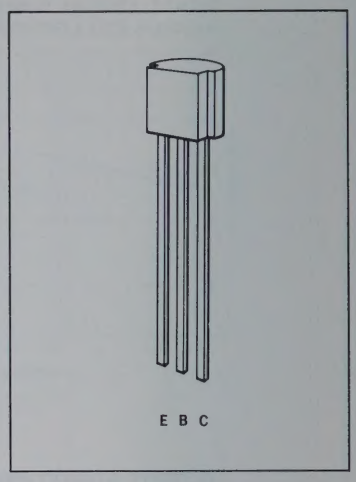


2N3905 • 2N3906

PNP GENERAL PURPOSE AMPLIFIERS AND SWITCHES

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **MEDIUM VOLTAGE . . . V_{CEO} = -40 V (MIN)**
- **HIGH GAIN . . . . . h_{FE} = 100-300 AT 10 mA**
- **LOW NOISE . . . . . NF = 4.0 dB (MAX) WIDEBAND**
- **COMPLEMENTARY TO 2N3903 • 2N3904**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	-55°C to +135°C
†Operating Junction Temperature	+135°C
†Lead Temperature (Soldering, 60 seconds time limit)	+230°C

Maximum Power Dissipation (Notes 2 and 3)

†Total Dissipation at 25°C Ambient Temperature	0.31 Watt
at 60°C Ambient Temperature	0.21 Watt

Maximum Voltages and Current

†V_{CBO}	Collector to Base Voltage	-40 Volts
†V_{CEO}	Collector to Emitter Voltage (Note 4)	-40 Volts
†V_{EBO}	Emitter to Base Voltage	-5.0 Volts
†I_C	Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N3905 MIN.	2N3905 MAX.	2N3906 MIN.	2N3906 MAX.	UNITS	TEST CONDITIONS	
†h_{FE}	DC Pulse Current Gain (Note 5)	30		60			I_C = 0.1 mA,	V_{CE} = -1.0 V
†h_{FE}	DC Pulse Current Gain (Note 5)	40		80			I_C = 1.0 mA,	V_{CE} = -1.0 V
†h_{FE}	**DC Pulse Current Gain (Note 5)**	**50**	**150**	**100**	**300**		**I_C = 10 mA,**	**V_{CE} = -1.0 V**
†h_{FE}	DC Pulse Current Gain (Note 5)	30		60			I_C = 50 mA,	V_{CE} = -1.0 V
†h_{FE}	DC Pulse Current Gain (Note 5)	15		30			I_C = 100 mA,	V_{CE} = -1.0 V
†$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		-0.25		-0.25	Volts	I_C = 10 mA,	I_B = 1.0 mA
†$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		-0.4		-0.4	Volts	I_C = 50 mA,	I_B = 5.0 mA
†$V_{BE(sat)}$	Base Saturation Voltage (Note 5)	-0.65	-0.85	-0.65	-0.85	Volts	I_C = 10 mA,	I_B = 1.0 mA
†$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		-0.95		-0.95	Volts	I_C = 50 mA,	I_B = 5.0 mA
†I_{CEX}	Collector Cutoff Current		50		50	nA	V_{CE} = -30V,	V_{BE} = 3.0 V
†I_{BL}	Base Cutoff Current		50		50	nA	V_{CE} = -30V,	V_{BE} = 3.0 V
†BV_{CBO}	Collector to Base Breakdown Voltage	-40		-40		Volts	I_C = 10 μA,	I_E = 0
†BV_{CEO}	**Collector to Emitter Breakdown Voltage (Note 5)**	**-40**		**-40**		**Volts**	**I_C = 1.0 mA**	**I_B = 0**
†BV_{EBO}	Base to Emitter Breakdown Voltage	-5.0		-5.0		Volts	I_C = 0,	I_E = 10 μA
†C_{obo}	Output Capacitance (f = 100 kHz)		4.5		4.5	pF	I_E = 0,	V_{CB} = -5.0 V
†C_{ibo}	Input Capacitance (f = 100 kHz)		10		10	pF	I_C = 0,	V_{EB} = -0.5 V
†h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.0		2.5			I_C = 1.0mA	V_{CE} = -20 V
†f_T	Current Gain Bandwidth Product (f = 100 MHz)	200		250		MHz	I_C = 10 mA,	V_{CE} = -20 V
†t_d	Delay Time (See Figure 1)		35		35	ns	$I_C \approx$ 10 mA,	$I_{B1} \approx$ 1.0 mA
†t_r	Rise Time (See Figure 1)		35		35	ns	$I_C \approx$ 10 mA,	$I_{B1} \approx$ 1.0 mA
†t_s	Storage Time (See Figure 2)		200		225	ns	$I_C \approx$ 10 mA, $I_{B2} \approx$ -1.0 mA	$I_{B1} \approx$ 1.0 mA
†t_f	Fall Time (See Figure 2)		60		75	ns	$I_C \approx$ 10 mA, $I_{B2} \approx$ -1.0 mA	$I_{B1} \approx$ 1.0 mA
†h_{ie}	Input Impedance (f = 1.0 kHz)	0.5	8.0	2.0	12	kΩ	I_C = 1.0 mA,	V_{CE} = -10 V
†h_{re}	Voltage Feedback Ratio (f=1.0 kHz)	0.1	5.0	1.0	10	$X10^{-4}$	I_C = 1.0 mA,	V_{CE} = -10 V
†h_{fe}	Small Signal Current Gain (f=1.0 kHz)	50	200	100	400		I_C = 1.0 mA,	V_{CE} = -10 V
†h_{oe}	Output Admittance (f = 1.0 kHz)	1.0	40	3.0	60	μmho	I_C = 1.0 mA,	V_{CE} = -10 V
†NF	**Noise Figure (f=10 Hz to 15.7 kHz)**		**5.0**		**4.0**	**dB**	**I_C = 100 μA, R_S = 1.0 kΩ**	**V_{CE} = -5.0 V**

†JEDEC Registered Values

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/ °C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse conditions: length = 300 μs; duty cycle = 2%.

FIGURE 1 – DELAY AND RISE TIME EQUIVALENT TEST CIRCUIT

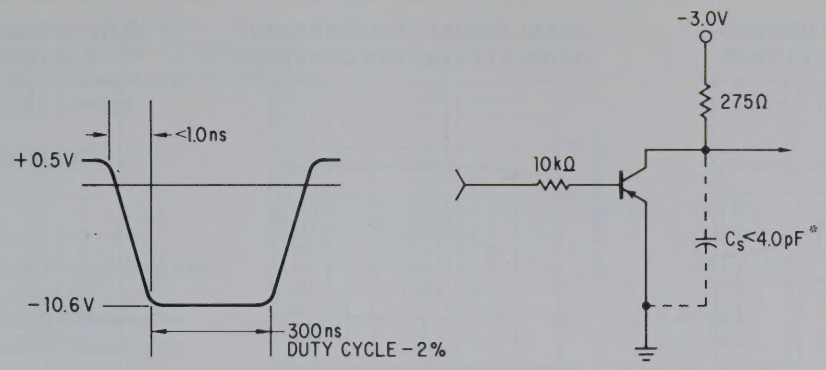
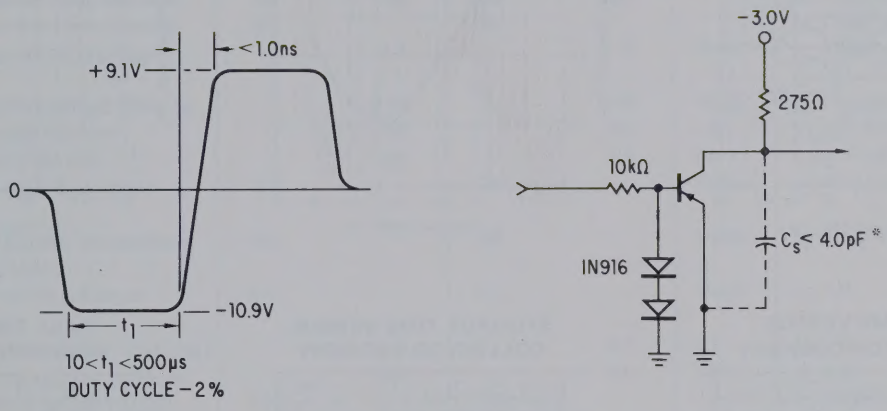


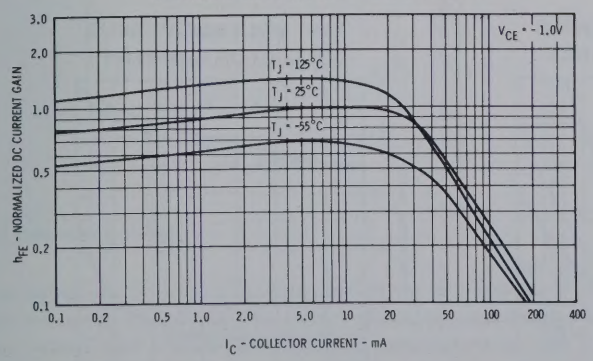
FIGURE 2 – STORAGE AND FALL TIME EQUIVALENT TEST CIRCUIT



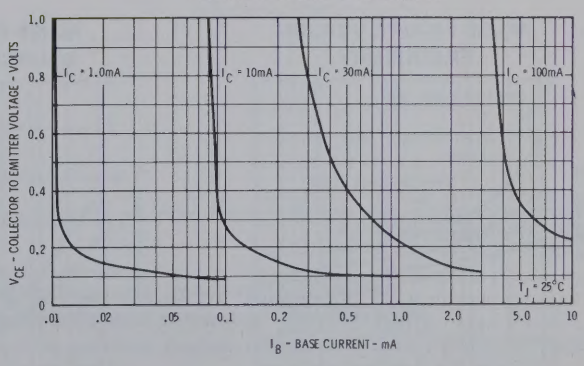
*Total shunt capacitance of test jig and connectors

TYPICAL ELECTRICAL CHARACTERISTICS

NORMALIZED DC CURRENT GAIN VERSUS COLLECTOR CURRENT

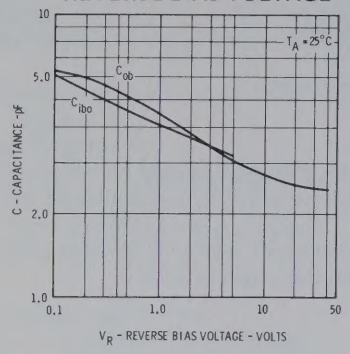


COLLECTOR TO EMITTER VOLTAGE VERSUS BASE CURRENT

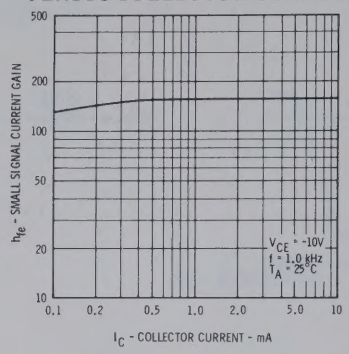


TYPICAL ELECTRICAL CHARACTERISTICS

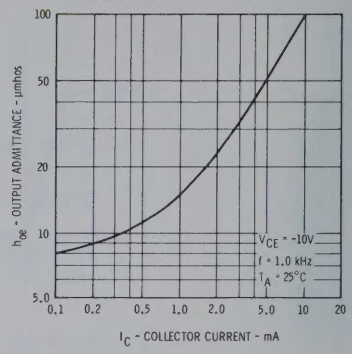
CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



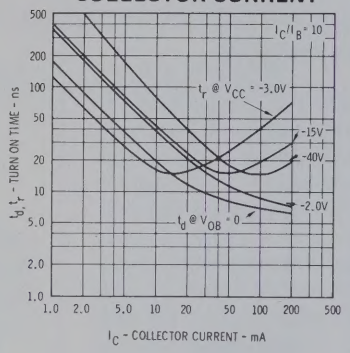
SMALL SIGNAL CURRENT GAIN VERSUS COLLECTOR CURRENT



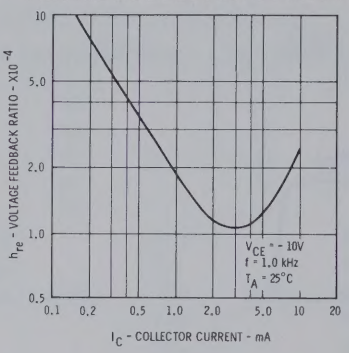
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT



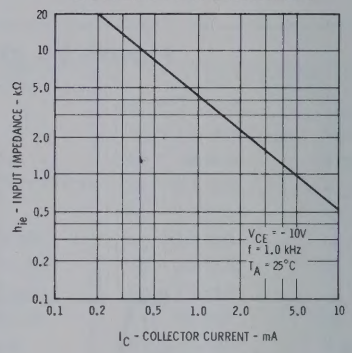
TURN ON TIME VERSUS COLLECTOR CURRENT



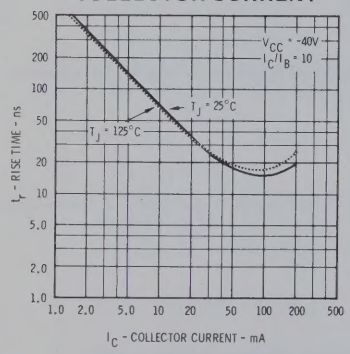
VOLTAGE FEEDBACK RATIO VERSUS COLLECTOR CURRENT



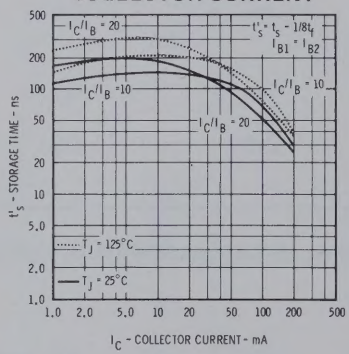
INPUT IMPEDANCE VERSUS COLLECTOR CURRENT



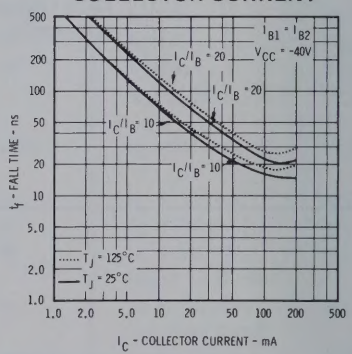
RISE TIME VERSUS COLLECTOR CURRENT



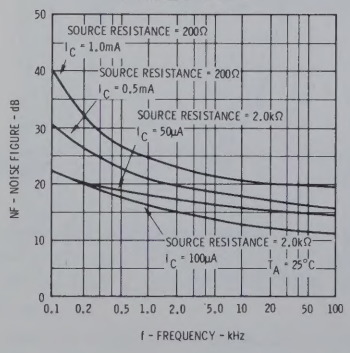
STORAGE TIME VERSUS COLLECTOR CURRENT



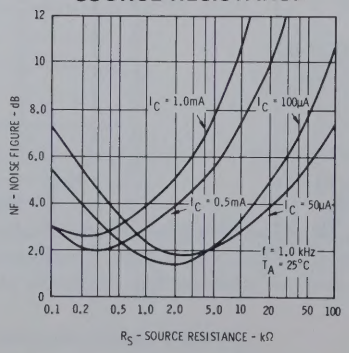
FALL TIME VERSUS COLLECTOR CURRENT



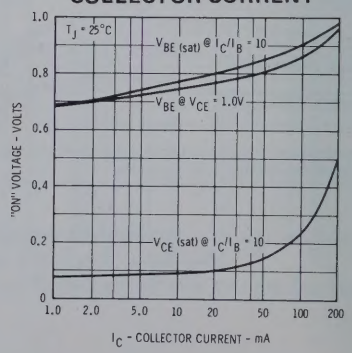
NOISE FIGURE VERSUS FREQUENCY



NOISE FIGURE VERSUS SOURCE RESISTANCE



"ON" VOLTAGE VERSUS COLLECTOR CURRENT

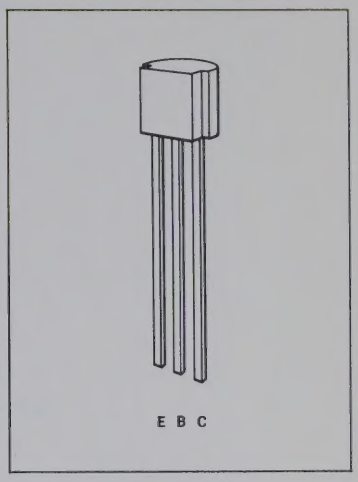


2N4123 • 2N4124

NPN GENERAL PURPOSE AMPLIFIERS AND SWITCHES

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **MEDIUM VOLTAGE . . . V_{CEO} = 25 V (MIN)**
- **HIGH GAIN . . . . . h_{FE} = 120-360 AT 2.0 mA**
- **LOW NOISE . . . . . NF = 5.0 dB (MAX) WIDEBAND**
- **COMPLEMENTARY TO 2N4125 • 2N4126**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	-55°C to +135°C
†Operating Junction Temperature	+135°C
†Lead Temperature (Soldering, 60 seconds time limit)	+230°C

Maximum Power Dissipation (Notes 2 and 3)

†Total Dissipation at 25°C Ambient Temperature	0.31 Watt
at 60°C Ambient Temperature	0.21 Watt

Maximum Voltages and Current

†V_{CBO}	Collector to Base Voltage	40 Volts	30 Volts
†V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts	25 Volts
†V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts
†I_C	Collector Current	200 mA	200 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4123 MIN.	2N4123 TYP.	2N4123 MAX.	2N4124 MIN.	2N4124 TYP.	2N4124 MAX.	UNITS	TEST CONDITIONS	
†h_{FE}	**DC Pulse Current Gain (Note 5)**	50		150	**120**		**360**		I_C = 2.0 mA,	V_{CE} = 1.0 V
†h_{FE}	DC Pulse Current Gain (Note 5)	25			60				I_C = 50 mA,	V_{CE} = 1.0 V
†$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)			0.3			0.3	Volts	I_C = 50 mA,	I_B = 5.0 mA
†$V_{BE(sat)}$	Base Saturation Voltage (Note 5)			0.95			0.95	Volts	I_C = 50 mA,	I_B = 5.0 mA
†I_{CBO}	Collector Cutoff Current			50			50	nA	V_{CB} = 20V,	I_E = 0
†I_{EBO}	Emitter Cutoff Current			50			50	nA	V_{EB} = 3.0 V,	I_C = 0
†BV_{CBO}	Collector to Base Breakdown Voltage	40			30			Volts	I_C = 10 μA,	I_E = 0
†BV_{CEO}	**Collector to Emitter Breakdown Voltage** (Note 5)	30			**25**			**Volts**	I_C = 1.0 mA,	I_B = 0
†BV_{EBO}	Base to Emitter Breakdown Voltage	5.0			5.0			Volts	I_C = 0	I_E = 10 μA
†C_{cb}	Output Capacitance (f = 100 kHz)			4.0			4.0	pF	I_E = 0,	V_{CB} = 5.0 V
†C_{ibo}	Input Capacitance (f = 100 kHz)			8.0			8.0	pF	I_C = 0,	V_{EB} = 0.5 V
†h_{fe}	High Frequency Current Gain (f=100 MHz)	2.5			3.0				I_C = 10 mA,	V_{CE} = 20 V
†f_T	Current Gain Bandwidth Product (f=100 MHz)	250			300			MHz	I_C = 10 mA,	V_{CE} = 20 V
t_d	Delay Time (See Figure 1)		24			24		ns	$I_C \approx$ 10 mA,	$I_{B1} \approx$ 1.0 mA
t_r	Rise Time (See Figure 1)		13			13		ns	$I_C \approx$ 10 mA,	$I_{B1} \approx$ 1.0 mA
t_s	Storage Time (See Figure 2)		125			125		ns	$I_C \approx$ 10 mA, $I_{B2} \approx$ 1.0 mA	$I_{B1} \approx$ 1.0 mA
t_f	Fall Time (See Figure 2)		11			11		ns	$I_C \approx$ 10 mA, $I_B \approx$ -1.0 mA	$I_{B1} \approx$ 1.0 mA
†h_{fe}	Small Signal Current Gain (f=1.0 kHz)	50		200	120		480		I_C = 2 mA,	V_{CE} = 1.0V
†NF	**Noise Figure (f=10 Hz to 15.7 kHz)**			6.0			**5.0**	**dB**	I_C = 100 μA, R_S = 1.0 kΩ	V_{CE} = 5.0 V

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse conditions: length = 300 μs; duty cycle = 2%.

FIGURE 1–DELAY AND RISE TIME EQUIVALENT TEST CIRCUIT

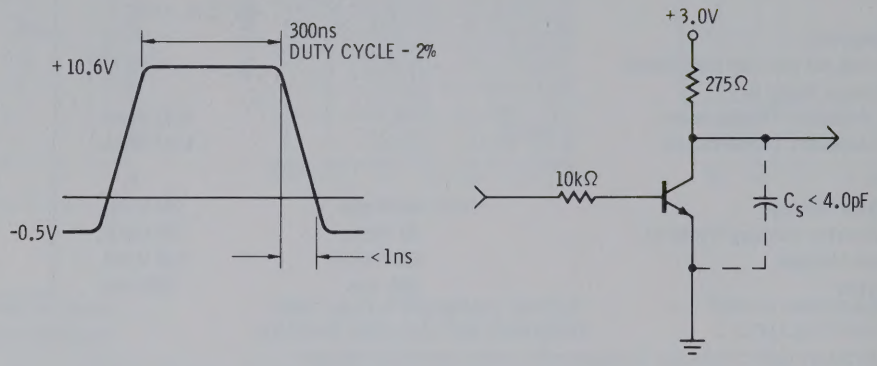
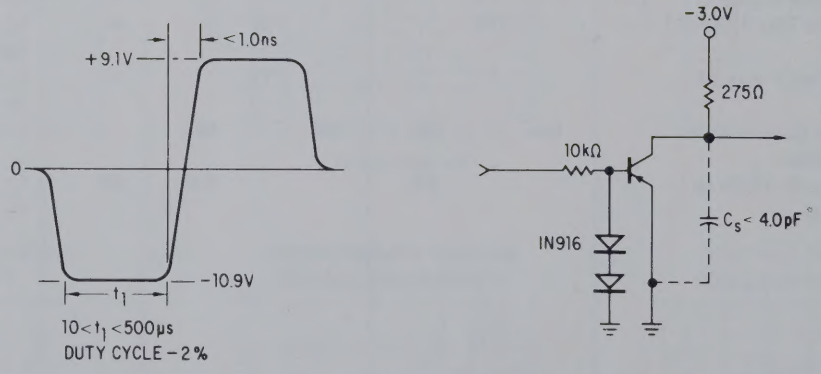


FIGURE 2–STORAGE AND FALL TIME EQUIVALENT TEST CIRCUIT



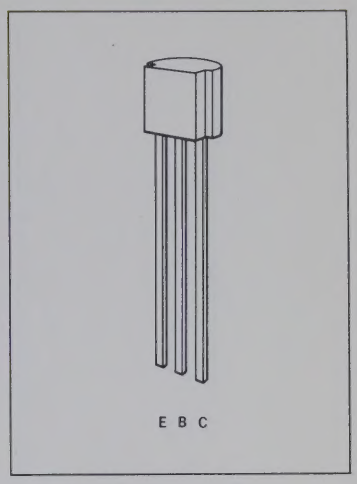
*Total shunt capacitance of test jig and connectors

2N4125 • 2N4126

PNP GENERAL PURPOSE AMPLIFIERS AND SWITCHES

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- MEDIUM VOLTAGE . . . V_{CEO} = -25 V (MIN)
- HIGH GAIN . . . . . h_{FE} = 120-360 AT 2.0 mA
- LOW NOISE . . . . . NF = 4.0 dB (MAX) WIDEBAND
- COMPLEMENTARY TO 2N4123 • 2N4124



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	-55° C to +135° C
†Operating Junction Temperature	-55° C to +135° C
†Lead Temperature (Soldering, 60 seconds time limit)	+230° C

Maximum Power Dissipation (Notes 2 and 3)

†Total Dissipation at 25° C Ambient Temperature	0.31 Watt
at 60° C Ambient Temperature	0.21 Watt

Maximum Voltage and Current

		2N4125	2N4126
†V_{CBO}	Collector to Base Voltage	-30 Volts	-25 Volts
†V_{CEO}	Collector to Emitter Voltage (Note 4)	-30 Volts	-25 Volts
†V_{EBO}	Emitter to Base Voltage	-4.0 Volts	-4.0 Volts
†I_C	Collector Current	200 mA	200 mA

ELECTRICAL CHARACTERISTICS (25° C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4125 MIN.	2N4125 TYP.	2N4125 MAX.	2N4126 MIN.	2N4126 TYP.	2N4126 MAX.	UNITS	TEST CONDITIONS	
†h_{FE}	**DC Pulse Current Gain** (Note 5)	50		150	**120**		**360**		I_C = **2.0 mA,**	V_{CE} = **-1.0 V**
h_{FE}	DC Pulse Current Gain (Note 5)	25			60				I_C = 50 mA,	V_{CE} = 1.0 V
†$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)			-0.4			-0.4	Volts	I_C = 50 mA,	I_B = 5.0 mA
†$V_{BE(sat)}$	Base Saturation Voltage (Note 5)			-0.95			-0.95	Volts	I_C = 50 mA,	I_B = 5.0 mA
†I_{CBO}	Collector Cutoff Current			50			50	nA	V_{CB} = -20 V,	I_E = 0
†I_{EBO}	Emitter Cutoff Current			50			50	nA	V_{EB} = -3.0V	I_C = 0
†BV_{CBO}	Collector to Base Breakdown Voltage	-30			-25			Volts	I_C = 10 μA,	I_E = 0
†**BV_{CEO}**	**Collector to Emitter Breakdown Voltage** (Note 5)	-30			**-25**			**Volts**	I_C = **1.0 mA,**	I_B = **0**
†BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0			-4.0			Volts	I_C = 0,	I_E = 10 μA
†C_{ob}	Output Capacitance (f = 100 kHz)			4.5			4.5	pF	I_E = 0,	V_{CB} = -5.0V
†C_{ibo}	Input Capacitance (f = 100 kHz)			10			10	pF	I_C = 0,	V_{EB} = -0.5 V
†h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.0			2.5				I_C = 10 mA,	V_{CE} = -20 V
†f_T	Current Gain Bandwidth Product (f = 100 MHz)	200			250			MHz	I_C = 10 mA,	V_{CE} = -20 V
t_d	Delay Time (See Figure 1)		25			25		ns	$I_C \approx$ 10 mA,	$I_{B1} \approx$ 1.0 mA
t_r	Rise Time (See Figure 1)		18			18		ns	$I_C \approx$ 10 mA,	$I_{B1} \approx$ 1.0 mA
t_s	Storage Time (See Figure 2)		140			140		ns	$I_C \approx$ 10 mA, $I_{B2} \approx$ 1.0 mA	$I_{B1} \approx$ 1.0 mA
t_f	Fall Time (See Figure 2)		15			15		ns	$I_C \approx$ 10 mA, $I_{B2} \approx$ -1.0 mA	$I_{B1} \approx$ 1.0 mA
†h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	50		200	120		480		I_C = 2.0 mA,	V_{CE} = -1.0V
†**NF**	**Noise Figure (f = 10 Hz to 15.7 kHz)**			5.0			**4.0**	**dB**	I_C = **100 μA,** R_S = **1.0 kΩ**	V_{CE} = **-5.0 V**

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 135° C and junction to ambient thermal resistance of 357° C/Watt (derating factor of 2.81 mW/° C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse Conditions: length = 300 μs; duty cycle = 2%.

Fig. 1 — DELAY AND RISE TIME EQUIVALENT TEST CIRCUIT

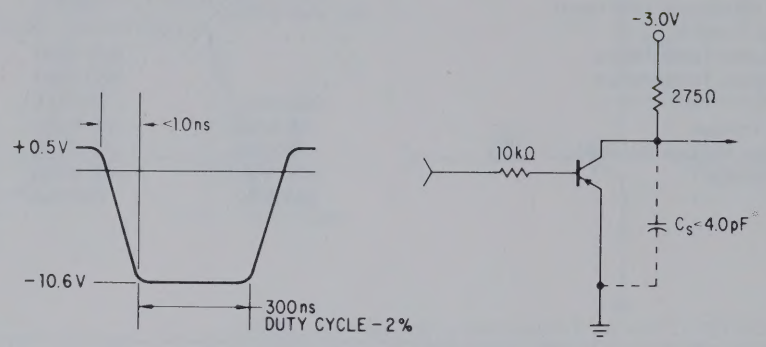
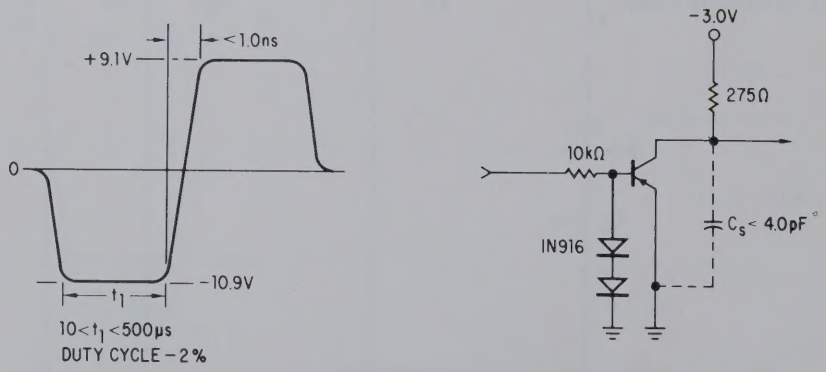


Fig. 2 — STORAGE AND FALL TIME EQUIVALENT TEST CIRCUIT



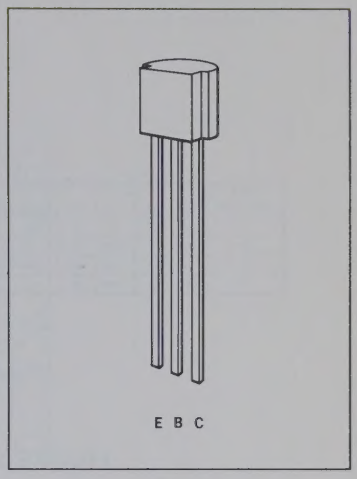
*Total shunt capacitance of test jig and connectors

2N4264 • 2N4265

NPN HIGH-SPEED SATURATED SWITCHES

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH FREQUENCY CURRENT GAIN** . . . . . f_T = 300 MHz (MIN) AT 10 mA
- **LOW CAPACITANCE** . . . . . C_{cb} = 4.0 pF (MAX)
- **LOW CHARGE STORAGE TIME** . . . . . T_s = 20 ns (MAX) AT 10 mA
- **LOW SATURATION VOLTAGE** . . . . . $V_{CE}(sat)$ = 0.22 V (MAX) AT 10 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	-55°C to +135°C
Operating Junction Temperature	-55°C to +135°C
†Lead Temperature (Soldering, 60 seconds time limit)	+230°C

Maximum Power Dissipation (Notes 2 and 3)

†Total Dissipation at 25°C Ambient Temperature	0.31 Watt
at 60°C Ambient Temperature	0.21 Watt

Maximum Voltages and Current

		2N4264	2N4265
V_{CBO}	Collector to Base Voltage	30 Volts	30 Volts
V_{CEO}	Collector to Emitter Voltage	15 Volts	12 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts	6.0 Volts
I_C	DC Collector Current	200 mA	200 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4264 MIN.	2N4264 MAX.	2N4265 MIN.	2N4265 MAX.	UNITS	TEST CONDITIONS	
†h_{FE}	DC Current Gain	25		50			I_C = 1.0 mA,	V_{CE} = 1.0 V
†h_{FE}	DC Current Gain	40	160	100	400		I_C = 10 mA,	V_{CE} = 1.0 V
†h_{FE}(T_A=55°C)	DC Current Gain	20		45			I_C = 10 mA,	V_{CE} = 1.0 V
†h_{FE}	DC Current Gain	40		90			I_C = 30 mA,	V_{CE} = 1.0 V
†h_{FE}	DC Pulse Current Gain (Note 5)	30		55			I_C = 100 mA,	V_{CE} = 1.0 V
†h_{FE}	DC Pulse Current Gain (Note 5)	20		35			I_C = 200 mA,	V_{CE} = 1.0 V
†V_{CE}(sat)	**Collector Saturation Voltage**		**0.22**		**0.22**	**Volts**	**I_C = 10 mA,**	**I_B = 1.0 mA**
†V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.35		0.35	Volts	I_C = 100 mA,	I_B = 10 mA
†V_{BE}(sat)	Base Saturation Voltage	0.65	0.80	0.65	0.80	Volts	I_C = 10 mA,	I_B = 1.0 mA
†V_{BE}(sat)	Base Saturation Voltage (note 5)	0.75	0.95	0.75	0.95	Volts	I_C = 100 mA,	I_B = 10 mA
†f_T	**Current Gain Bandwidth Product (f = 100 MHz)**	**300**		**300**		**MHz**	**I_C = 10 mA,**	**V_{CE} = 10 V**
†h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0		3.0			V_{CE} = 10 V	I_C = 10 mA
†C_{cb}	**Collector Base Capacitance (f=100kHz)**		**4.0**		**4.0**	**pF**	**I_E = 0**	**V_{CB}= 5.0 V**
†C_{IB}	Input Capacitance (f= 100kHz)		8.0		8.0	pF	V_{BE} = 0.5 V,	I_C = 0
†I_{CEX}	Collector Cutoff Current		100		100	nA	V_{CE} = 12 V,	$V_{EB(off)}$ = 0.25 V
†I_{BL}	Base Cutoff Current		100		100	nA	V_{CE} = 12 V,	$V_{EB(off)}$ = 0.25 V
†I_{BL}(100°C)	Base Cutoff Current		10		10	µA	V_{CE} = 12 V,	$V_{EB(off)}$ = 0.25 V
†BV_{CBO}	Collector to Base Breakdown Voltage	30		30		Volts	I_C = 10 µA,	I_E = 0
†BV_{CEO}	Collector to Emitter Breakdown Voltage	15		12		Volts	I_C = 1.0 mA,	I_E = 0
†BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		Volts	I_C = 0,	I_E = 10 µA
†t_s	Storage Time (Figure 1, Condition B)		20		20	ns	$I_C \approx I_{B1} \approx$	I_{B2} = 10 mA
†t_{on}	Turn On Time (Figure 1, Condition A)		25		25	ns	$I_C \approx$ 10 mA,	I_B = 3.0 mA
†t_{off}	Turn Off Time (Figure 1, Condition A)		35		35	ns	$I_C \approx$ 10 mA,	$I_{B1} \approx$ 3.0 mA
							$I_{B2} \approx$ 1.5 mA	
†t_d	Delay Time (Figure 1, Conditon C)		8.0		8.0	ns	I_C = 100 mA,	I_{B1} = 10 mA
†t_r	Rise Time (Figure 1, Condition C)		15		15	ns	I_C = 100 mA,	I_{B1} = 10 mA
†t_s	Storage Time (Figure 1, Condition C)		20		20	ns	I_C = 100 mA,	I_{B1}=I_{B2}=10 mA
†t_f	Fall Time (Figure 1, Condition C)		15		15	ns	I_C = 100 mA,	I_{B1}=I_{B2}=10 mA
†Q_T	Total Charge Control (Figure 2)		80		80	pC	I_C = 10 mA,	I_B = 1.0 mA

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse conditions: length = 300 µs; duty cycle = 2%.

FIGURE 1 SWITCHING TIME EQUIVALENT TEST CIRCUIT

TEST CONDITION	I_C	V_{CC}	R_B	R_C	$C_{S(max)}$	$V_{EB(off)}$	V_1	V_2	V_3
	mA	V	Ω	Ω	pF	V	V	V	V
A	10	3	3300	270	4	−1.5	10.55	−4.15	10.70
B	10	10	560	960	4	–	–	−4.65	6.55
C	100	10	560	96	12	−2.0	6.35	−4.65	6.55

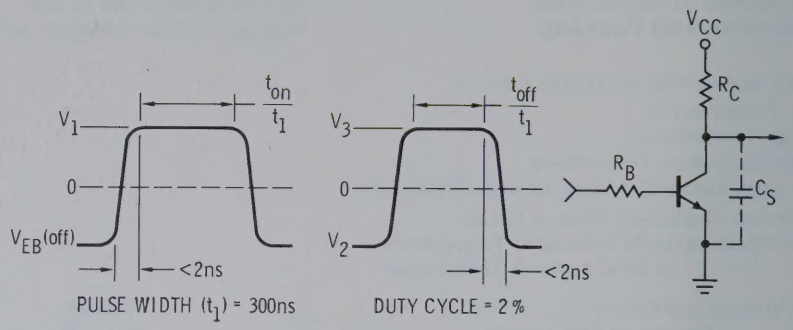


FIGURE 2 Q_T TEST CIRCUIT

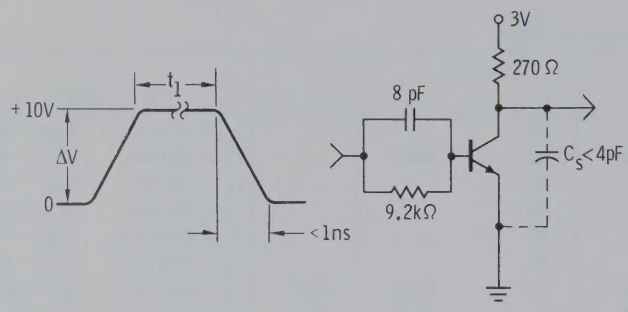
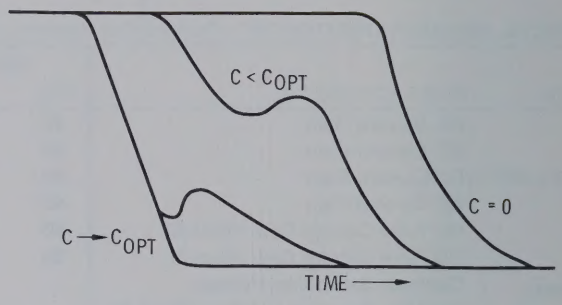


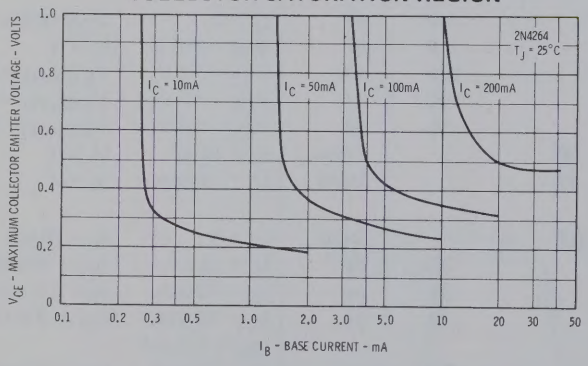
FIGURE 3 TURN-OFF WAVEFORM



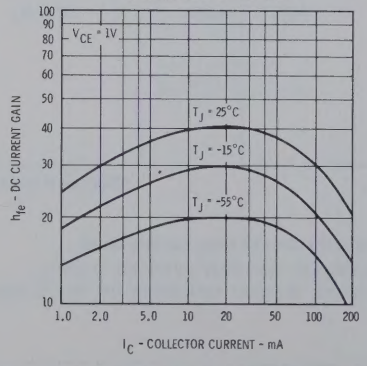
TYPICAL ELECTRICAL CHARACTERISTICS

2N4264

COLLECTOR SATURATION REGION

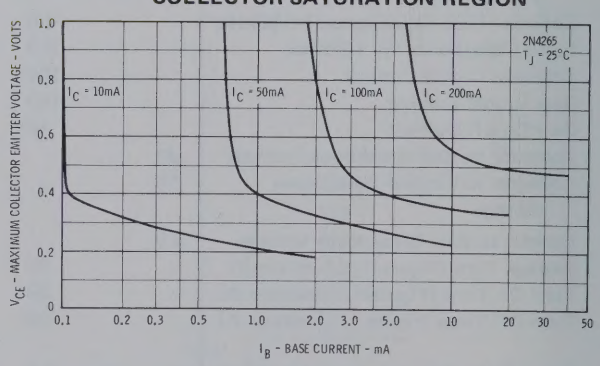


CURRENT GAIN

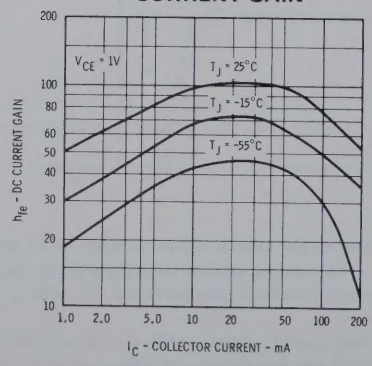


2N4265

COLLECTOR SATURATION REGION

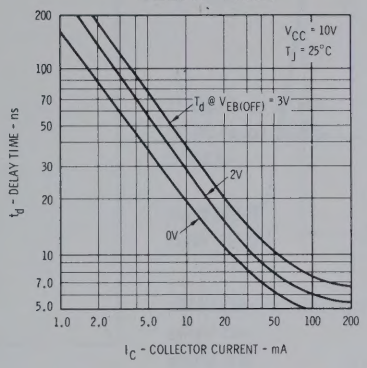


CURRENT GAIN

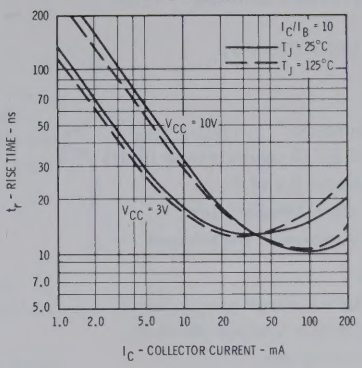


TYPICAL ELECTRICAL CHARACTERISTICS

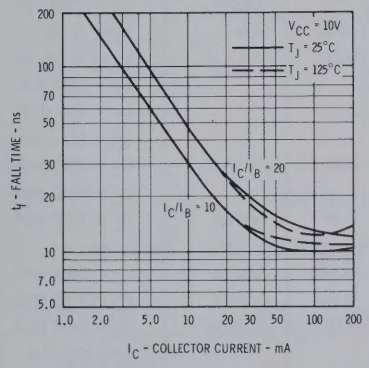
DELAY TIME



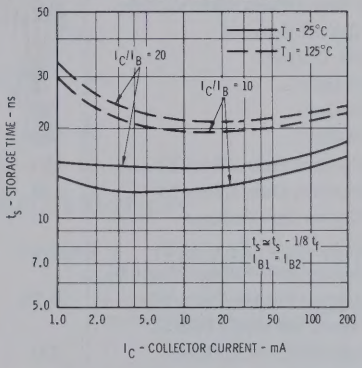
RISE TIME



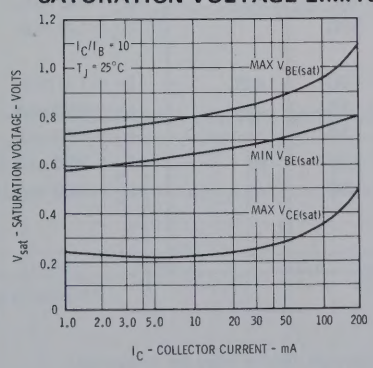
FALL TIME



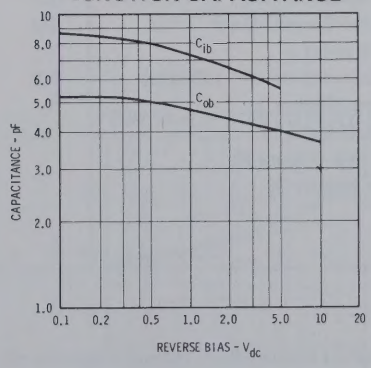
STORAGE TIME



SATURATION VOLTAGE LIMITS



JUNCTION CAPACITANCE

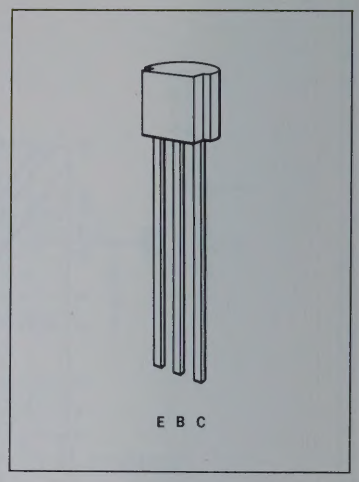


2N4400 • 2N4401

NPN GENERAL PURPOSE AMPLIFIERS AND SWITCHES

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **MEDIUM VOLTAGE** . . . . . V_{CEO} = 40 V (MIN)
- **HIGH GAIN** . . . . . h_{FE} = 100-300 AT 150 mA
  . . . . . h_{FE} = 40 (MIN) AT 500 mA
- **MEDIUM SPEED** . . . . . t_{on} = 35 ns (MAX) AT 150 mA
  . . . . . t_{off} = 255 ns (MAX) AT 150 mA
- **COMPLEMENTARY TO 2N4402 • 2N4403**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	−55° C to +135° C
Operating Junction Temperature	−55° C to +135° C
†Lead Temperature (Soldering, 10 seconds time limit)	+230° C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25° C Case Temperature	0.80 Watt
† at 25° C Ambient Temperature	0.31 Watt

Maximum Voltages and Current

†V_{CBO}	Collector to Base Voltage	60 Volts
†V_{CEO}	Collector to Emitter Voltage (Note 4)	40 Volts
†V_{EBO}	Emitter to Base Voltage	6.0 Volts
†I_C	Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25° C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4400 MIN.	2N4400 MAX.	2N4401 MIN.	2N4401 MAX.	UNITS	TEST CONDITIONS
†BV_{CEO}(sust)	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	40		40		Volts	I_C = 1.0 mA, I_B = 0
†BV_{CBO}	Collector to Base Breakdown Voltage	60		60		Volts	I_C = 100 μA, I_E = 0
†BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		Volts	I_E = 100 μA, I_C = 0
†I_{CEX}	Collector Cutoff Current		100		100	nA	V_{CE} = 35 V, $V_{EB(off)}$ = 0.4 V
†I_{BL}	Base Reverse Current		100		100	nA	V_{CE} = 35 V, $V_{EB(off)}$ = 0.4 V
†h_{FE}	DC Current Gain			20			I_C = 100 μA, V_{CE} = 1.0 V
†h_{FE}	DC Current Gain	20		40			I_C = 1.0 mA, V_{CE} = 1.0 V
†h_{FE}	DC Current Gain	40		80			I_C = 10 mA, V_{CE} = 1.0 V
†h_{FE}	**DC Pulse Current Gain (Note 5)**	50	150	**100**	**300**		**I_C = 150 mA, V_{CE} = 1.0 V**
†h_{FE}	**DC Pulse Current Gain (Note 5)**	20		**40**			**I_C = 500 mA, V_{CE} = 2.0 V**
†V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.4		0.4	Volts	I_C = 150 mA, I_B = 15 mA
†V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.75		0.75	Volts	I_C = 500 mA, I_B = 50 mA
†V_{BE}(sat)	Base Saturation Voltage (Note 5)	0.75	0.95	0.75	0.95	Volts	I_C = 150 mA, I_B = 15 mA
†V_{BE}(sat)	Base Saturation Voltage (Note 5)		1.2		1.2	Volts	I_C = 500 mA, I_B = 50 mA
†h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.0		2.5			I_C = 20 mA, V_{CE} = 10 V
†f_T	Current Gain Bandwidth Product (f = 100 MHz)	200		250		MHz	I_C = 20 mA, V_{CE} = 10 V
†C_{cb}	Collector to Base Capacitance (f = 100kHz)		6.5		6.5	pF	V_{CB} = 5.0 V, I_E = 0
†C_{eb}	Emitter to Base Capacitance (f = 100 kHz)		30		30	pF	V_{EB} = 0.5 V, I_C = 0
†h_{ie}	Input Impedance (f = 1.0 kHz)	0.5	7.5	1.0	15	kΩ	I_C = 1.0 mA, V_{CE} = 10 V
†h_{re}	Voltage Feedback Ratio (f=1.0 kHz)	0.1	8.0	0.1	8.0	$X10^{-4}$	I_C = 1.0 mA, V_{CE} = 10 V
†h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	20	250	40	500		I_C = 1.0 mA, V_{CE} = 10 V
†h_{oe}	Output Admittance (f = 1.0 kHz)	1.0	30	1.0	30	μ℧	I_C = 1.0 mA, V_{CE} = 10 V
†t_d	**Delay Time (Figure 1)**		**15**		**15**	ns	**I_C = 150 mA, I_{B1} = 15 mA**
†t_r	**Rise Time (Figure 1)**		**20**		**20**	ns	**I_C = 150 mA, I_{B1} = 15 mA**
†t_s	**Storage Time (Figure 2)**		**225**		**225**	ns	**I_C = 150 mA, I_{B1}=I_{B2} = 15 mA**
†t_f	**Fall Time (Figure 2)**		**30**		**30**	ns	**I_C = 150 mA, I_{B1} = I_{B2} = 15 mA**

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

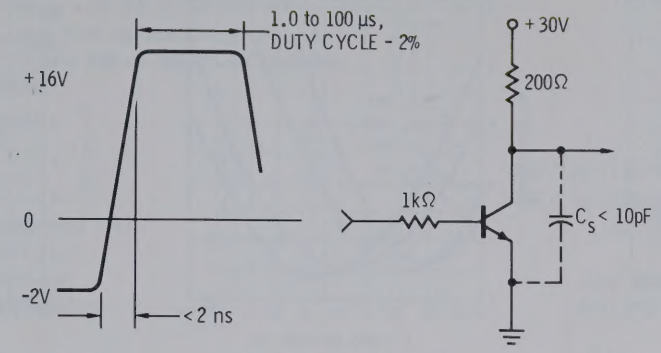
(3) These ratings give a maximum junction temperature of 135° C and junction to case thermal resistance of 137° C/Watt (derating factor of 7.30 mW/° C/Watt (derating factor of 2.81 mW/° C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse conditions: length ≤ 300 μs; duty cycle ≤ 2%.

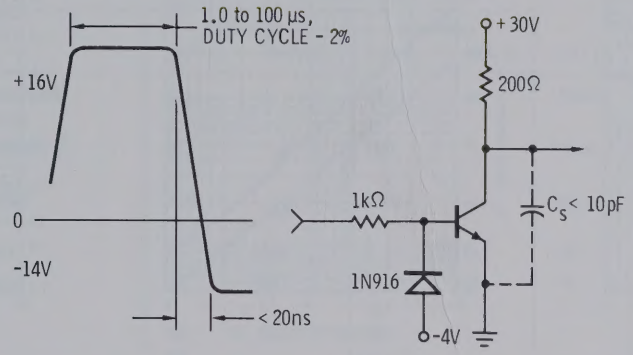
SWITCHING TIME EQUIVALENT TEST CIRCUITS

FIGURE 1 – TURN ON TIME



SCOPE RISE TIME < 4 ns
TOTAL SHUNT CAPACITANCE OF TEST JIG CONNECTORS AND OSCILLOSCOPE

FIGURE 2 – TURN OFF TIME



TYPICAL ELECTRICAL CHARACTERISTICS

FIGURE 1 – DC CURRENT GAIN

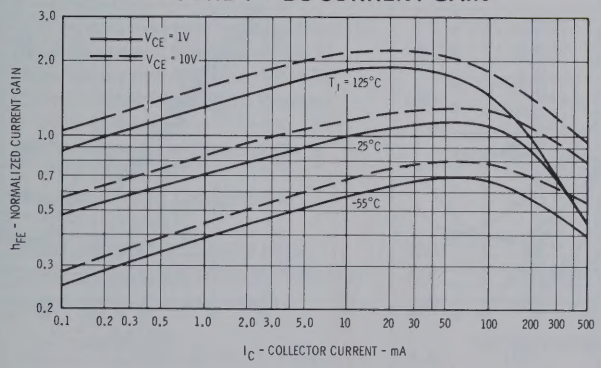


FIGURE 2 – TEMPERATURE COEFFICIENTS

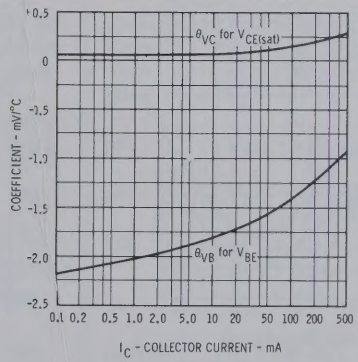


FIGURE 3 – COLLECTOR SATURATION REGION

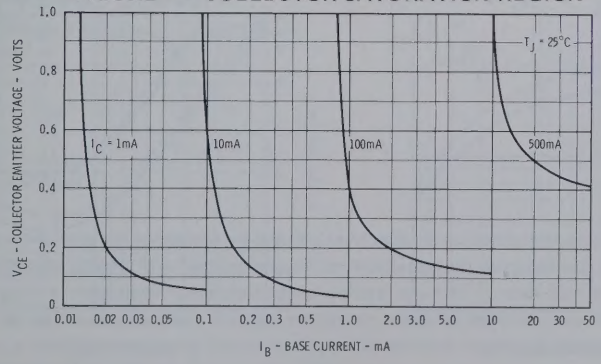
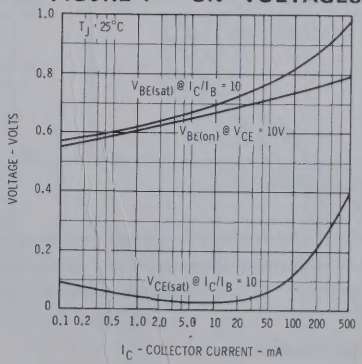


FIGURE 4 – "ON" VOLTAGES



TYPICAL ELECTRICAL CHARACTERISTICS

FIGURE 5
NOISE FIGURE VS FREQUENCY

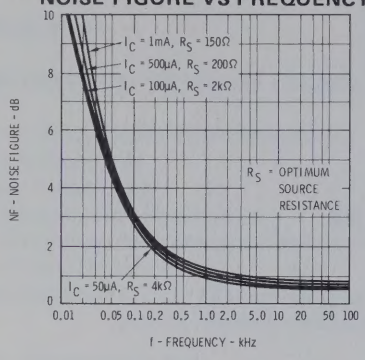

NF - NOISE FIGURE - dB
I_C = 1mA, R_S = 150Ω
I_C = 500μA, R_S = 200Ω
I_C = 100μA, R_S = 2kΩ
R_S = OPTIMUM SOURCE RESISTANCE
I_C = 50μA, R_S = 4kΩ
f - FREQUENCY - kHz

FIGURE 6
NOISE FIGURE VERSUS SOURCE RESISTANCE

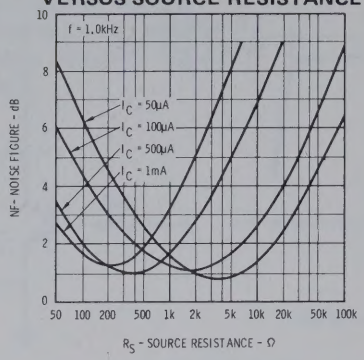


FIGURE 7
CAPACITANCES VERSUS VOLTAGE

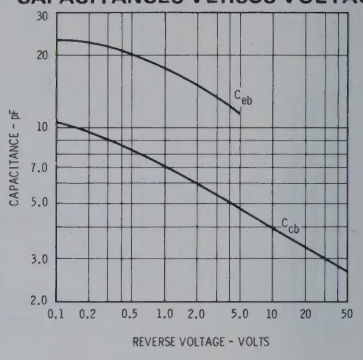


FIGURE 8 – CURRENT GAIN

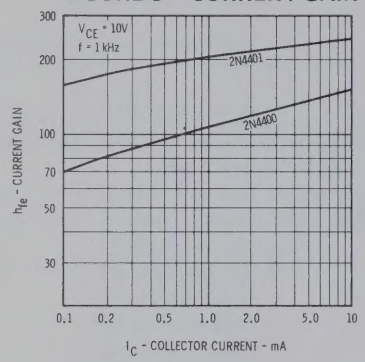


FIGURE 9 – INPUT IMPEDANCE

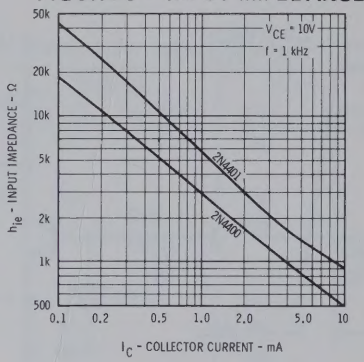


FIGURE 10 – CHARGE DATA

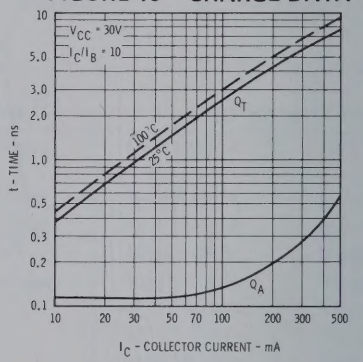


FIGURE 11 – VOLTAGE FEEDBACK RATIO

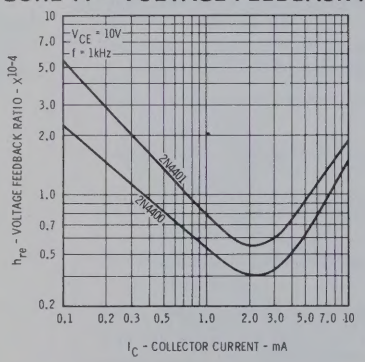


FIGURE 12 – TURN ON TIME

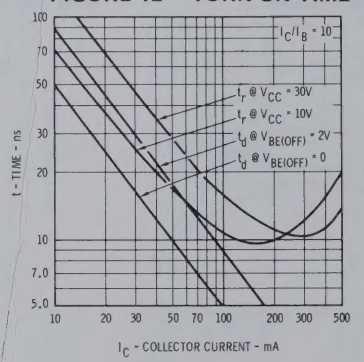


FIGURE 13 – RISE AND FALL TIMES

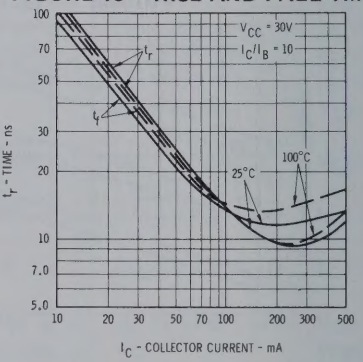


FIGURE 14 – OUTPUT ADMITTANCE

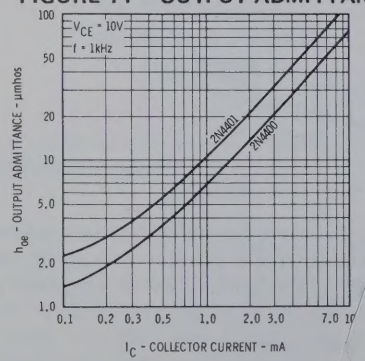


FIGURE 15 – STORAGE TIME

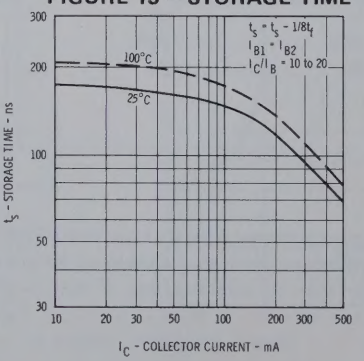
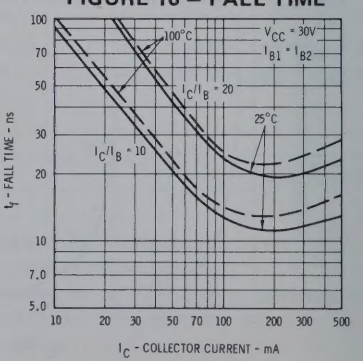


FIGURE 16 – FALL TIME

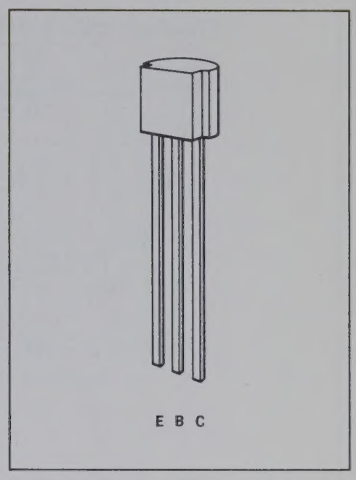


2N4402 • 2N4403

PNP GENERAL PURPOSE AMPLIFIERS AND SWITCHES

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **MEDIUM VOLTAGE** . . . . . V_{CEO} = –40 V (MIN)
- **HIGH GAIN** . . . . . h_{FE} = 100-300 AT 150 mA
  . . . . . h_{FE} = 20 (MIN) AT 500 mA
- **MEDIUM SPEED** . . . . . t_{on} = 35 ns (MAX) AT 150 mA
  . . . . . t_{off} = 255 ns (MAX) AT 150 mA
- **COMPLEMENTARY TO 2N4400 • 2N4401**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	–55°C to +135°C
Operating Junction Temperature	–55°C to +135°C
†Lead Temperature (Soldering, 10 seconds time limit)	+230°C

Maximum Power Dissipation (Notes 2 and 3)

†Total Dissipation at 25°C Case Temperature	0.80 Watt
at 25°C Ambient Temperature	0.31 Watt

Maximum Voltages and Current

†V_{CBO}	Collector to Base Voltage	–40 Volts
†V_{CEO}	Collector to Emitter Voltage (Note 4)	–40 Volts
†V_{EBO}	Emitter to Base Voltage	–5.0 Volts
†I_C	Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4402 MIN.	2N4402 MAX.	2N4403 MIN.	2N4403 MAX.	UNITS	TEST CONDITIONS
†BV_{CEO}(sust)	**Collector to Emitter Sustaining Voltage (Notes 4 and 5)**	**–40**		**–40**		**Volts**	**I_C = 1.0 mA, I_B = 0**
†BV_{CBO}	Collector to Base Breakdown Voltage	–40		–40		Volts	I_C = 100 μA, I_E = 0
†BV_{EBO}	Emitter to Base Breakdown Voltage	–5.0		–5.0		Volts	I_E = 100 μA, I_C = 0
†I_{CEX}	Collector Reverse Current		100		100	nA	V_{CE} = –35 V, $V_{EB(off)}$ = –0.4 V
†I_{BL}	Base Reverse Current		100		100	nA	V_{CE} = –35 V, $V_{EB(off)}$ = –0.4 V
†h_{FE}	DC Current Gain			30			I_C = 100 μA, V_{CE} = –1.0 V
†h_{FE}	DC Current Gain	30		60			I_C = 1.0 mA, V_{CE} = –1.0 V
†h_{FE}	DC Current Gain	50		100			I_C = 10 mA, V_{CE} = –1.0 V
†h_{FE}	**DC Pulse Current Gain (Note 5)**	50	150	**100**	**300**		**I_C = 150 mA, V_{CE} = –2.0 V**
†h_{FE}	**DC Pulse Current Gain (Note 5)**	**20**		**20**			**I_C = 500 mA, V_{CE} = –2.0 V**
†V_{CE}(sat)	Collector Saturation Voltage (Note 5)		–0.4		–0.4	Volts	I_C = 150 mA, I_B = 15 mA
†V_{CE}(sat)	Collector Saturation Voltage (Note 5)		–0.75		–0.75	Volts	I_C = 500 mA, I_B = 50 mA
†V_{BE}(sat)	Base Saturation Voltage (Note 5)	–0.75	–0.95	–0.75	–0.95	Volts	I_C = 150 mA, I_B = 15 mA
†V_{BE}(sat)	Base Saturation Voltage (Note 5)		–1.3		–1.3	Volts	I_C = 500 mA, I_B = 50 mA
†f_T	Current Gain Bandwidth Product (f = 100 MHz)	150		200		MHz	I_C = 20 mA, V_{CE} = –10 V
†C_{cb}	Collector to Base Capacitance (f = 140 kHz)		8.5		8.5	pF	V_{CB} = –10 V, I_E = 0
†C_{eb}	Emitter to Base Capacitance (f = 140 kHz)		30		30	pF	V_{EB} = –0.5 V I_C = 0
†h_{ie}	Input Impedance (f = 1.0 kHz)	750	7.5K	1.5K	15K	kΩ	I_C = 1.0 mA, V_{CE} = –10 V
†h_{re}	Voltage Feedback Ratio (f=1.0 kHz)	0.1	8.0x10-4	0.1	8.0x10-4		I_C = 1.0 mA, V_{CE} = –10 V
†h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	30	250	60	500		I_C = 1.0 mA, V_{CE} = –10 V
†h_{oe}	Output Admittance (f = 1.0 kHz)	1.0	100	1.0	100	μmhos	I_C = 1.0 mA, V_{CE} = –10 V
†t_d	**Delay Time (Figure 1)**		**15**		**15**	**ns**	**I_C = 150 mA, I_{B1} = 15 mA**
†t_r	**Rise Time (Figure 1)**		**20**		**20**	**ns**	**I_C = 150 mA, I_{B1} = 15 mA**
†t_s	**Storage Time (Figure 2)**		**225**		**225**	**ns**	**I_C = 150 mA, I_{B1} = –I_{B2} = 15 mA**
†t_f	**Fall Time (Figure 2)**		**30**		**30**	**ns**	**I_C = 150 mA, I_{B1} = –I_{B2} = 15 mA**
†h_{fe}	High Frequency Current Gain	1.5		2.0			I_C = 20 mA, V_{CE} = –10 V

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

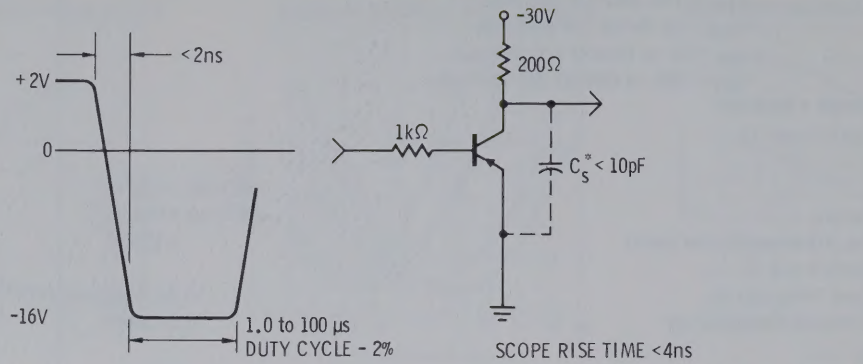
(3) These ratings give a maximum junction temperature of 135°C and junction to case thermal resistance of 137°C/Watt (derating factor of: 7.30 mW/°C); junction to ambient thermal resistance of 350/°C/Watt (derating factor of 2.81 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse conditions: length = 300 μs; duty cycle ≤2%.

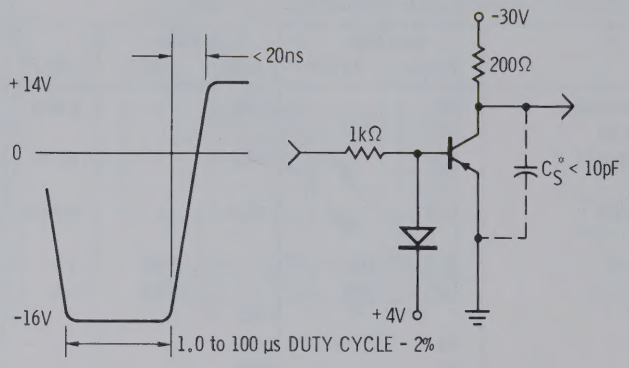
SWITCHING TIME EQUIVALENT TEST CIRCUIT

FIGURE 1 TURN ON TIME



SCOPE RISE TIME <4ns
*TOTAL SHUNT CAPACITANCE OF TEST JIG CONNECTORS AND OSCILLATORS

FIGURE 2 – TURN OFF TIME



TYPICAL ELECTRICAL CHARACTERISTICS

FIGURE 1 DC CURRENT GAIN

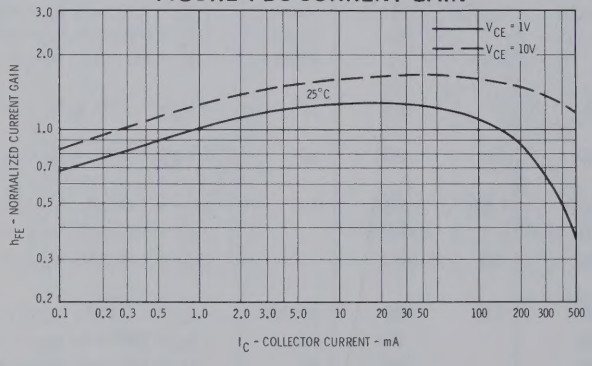


FIGURE 2 CAPACITANCE VERSUS VOLTAGE

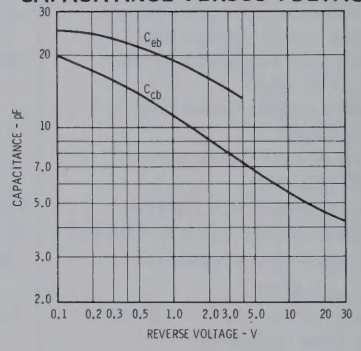


FIGURE 3 COLLECTOR SATURATION REGION

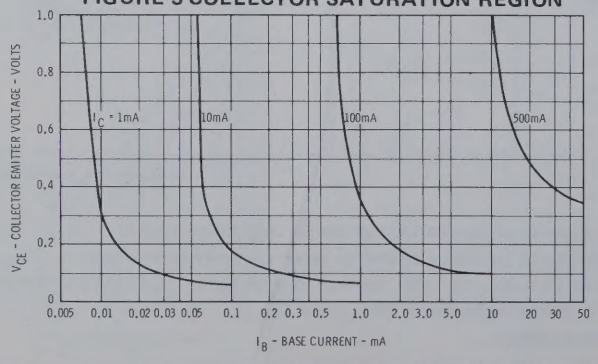
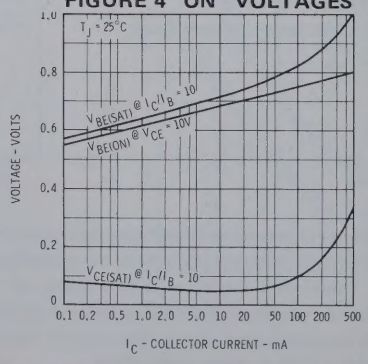
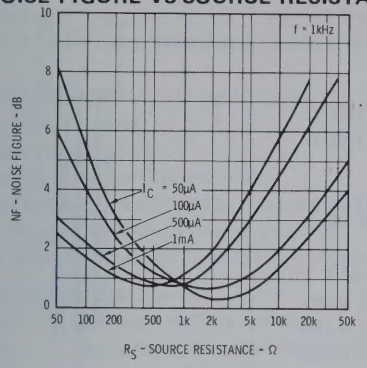


FIGURE 4 "ON" VOLTAGES

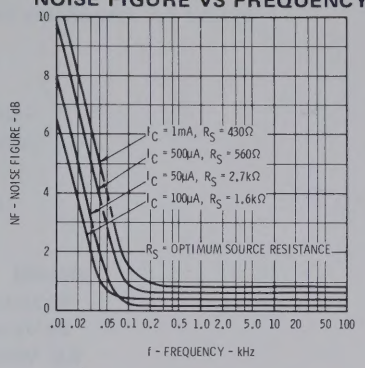


TYPICAL ELECTRICAL CHARACTERISTICS

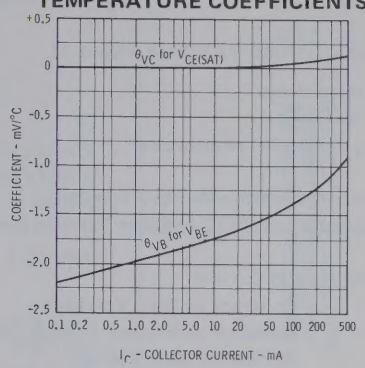
NOISE FIGURE VS SOURCE RESISTANCE



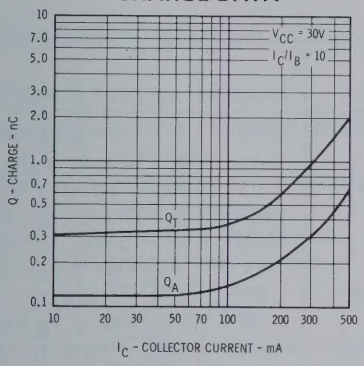
NOISE FIGURE VS FREQUENCY


I_C = 1mA, R_S = 430Ω
I_C = 500µA, R_S = 560Ω
I_C = 50µA, R_S = 2.7kΩ
I_C = 100µA, R_S = 1.6kΩ
R_S = OPTIMUM SOURCE RESISTANCE
NF - NOISE FIGURE - dB
f - FREQUENCY - kHz

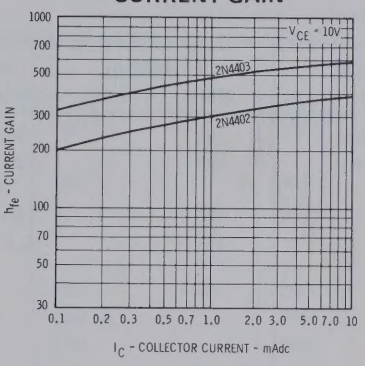
TEMPERATURE COEFFICIENTS



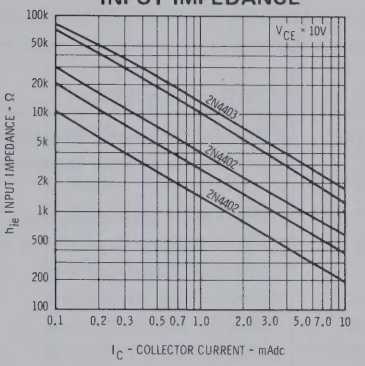
CHARGE DATA



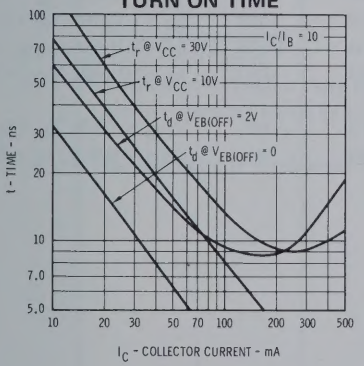
CURRENT GAIN



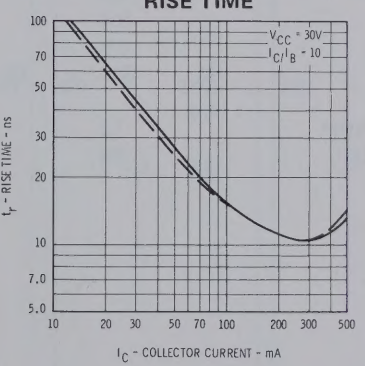
INPUT IMPEDANCE



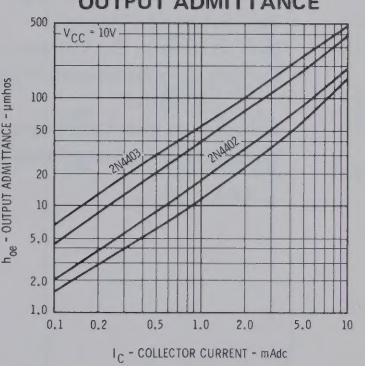
TURN ON TIME



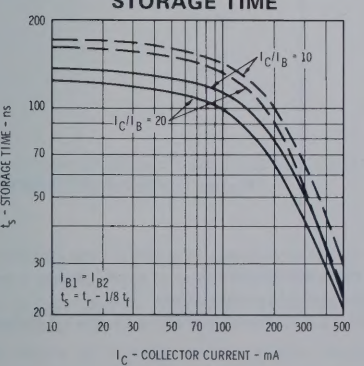
RISE TIME



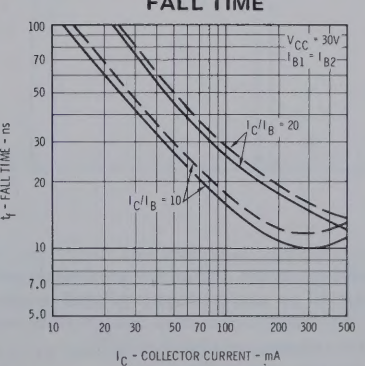
OUTPUT ADMITTANCE



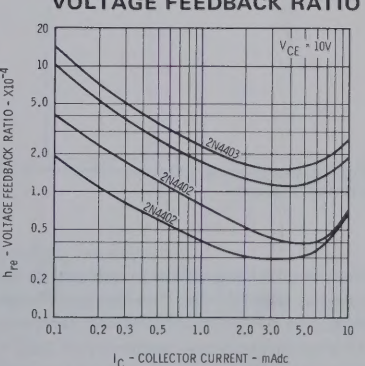
STORAGE TIME



FALL TIME



VOLTAGE FEEDBACK RATIO

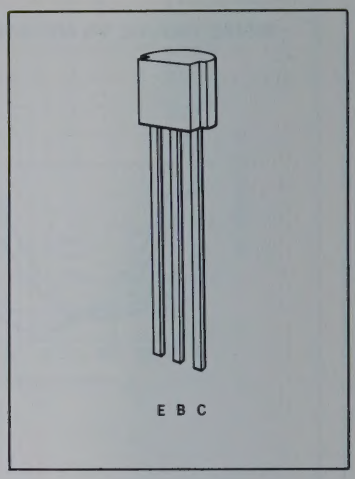


2N4409 • 2N4410

NPN HIGH VOLTAGE NEON DISPLAY TUBE DRIVERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH VOLTAGE . . . . . V_{CEO} = 80 V (MIN)**
- **HIGH GAIN . . . . . h_{fe} – 60 (MIN) AT 1.0 & 10 mA**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	–55°C to +135°C
Operating Junction Temperature	–55°C to +135°C

Maximum Power Dissipation (Notes 2 and 3)

†Total Dissipation at 25°C Ambient Temperature	0.31 Watt

Maximum Voltages and Current

		2N4409	2N4410
†V_{CBO}	Collector to Base Voltage	80 Volts	120 Volts
†V_{CEO}	Collector to Emitter Voltage (Note 4)	50 Volts	80 Volts
†V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts
†I_C	Collector Current	250 mA	250 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N4409 MIN	2N4409 MAX	2N4410 MIN	2N4410 MAX	UNITS	TEST CONDITIONS
†BV_{CEO}	Collector to Emitter Breakdown Voltage	50		80		Volts	I_C = 1.0 mA, I_B = 0
†BV_{CEX}	Collector to Emitter Breakdown Voltage	80		120		Volts	I_C = 500μA, V_{BB}=-5.0V R_{BE} = 8.2 kΩ
†BV_{CBO}	Collector to Base Breakdown Voltage	80		120		Volts	I_C = 10 μA, I_E = 0
†BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		Volts	I_E = 10 μA, I_C = 0
†I_{CBO}	Collector Cutoff Current		10			nA	V_{CB} = 60 V, I_E = 0
†I_{CBO}	Collector Cutoff Current				10	nA	V_{CB} = 100 V, I_E = 0
†I_{CBO}(100°C)	Collector Cutoff Current		1.0			μA	V_{CB} = 60 V, I_E = 0
†I_{CBO}(100°C)	Collector Cutoff Current				1.0	μA	V_{CB} = 100 V, I_E = 0
†I_{EBO}	Emitter Cutoff Current		100		100	nA	V_{EB} = 4.0 V, I_C = 0
†h_{fe}	DC Current Gain	60	400	60			I_C = 1.0 mA, V_{CE} = 1.0V
†h_{fe}	DC Pulse Current Gain (Note 5)	60		60	400		I_C = 10 mA, V_{CE} = 1.0V
†V_{CE}(sat)	Collector Saturation Voltage		0.2		0.2	Volts	I_C = 1.0 mA, I_B = 0.1 mA
†V_{BE}(sat)	Base Saturation Voltage		0.8		0.8	Volts	I_C = 1.0 mA, I_B = 0.1 mA
†V_{BE}(on)	Base to Emitter On Voltage		0.8		0.8	Volts	I_C = 1.0 mA, V_{CE} = 5.0 V
†f_t	Current Gain Bandwidth Product (f = 30 MHz)	60	300	60	300	MHz	I_C = 10 mA, V_{CE} = 10 V
†C_{cb}	Collector to Base Capacitance (f=100kHz)		12		12	pF	V_{CB} = 10 V, I_E = 0
C_{eb}	Emitter to Base Capacitance (f=100kHz)		50		50	pF	V_{BE} = 0.5 V, I_C = 0

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

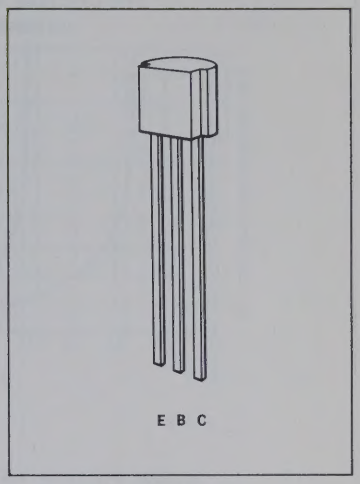
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

2N5086 • 2N5087

PNP LOW LEVEL, LOW NOISE, HIGH GAIN AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH VOLTAGE . . . . . V_{CEO} = -50 V (MIN)**
- **HIGH GAIN . . . . . h_{FE} = 250 (MIN) FROM 100 μA TO 10 mA**
- **LOW NOISE . . . . . NF = 2.0 dB (MAX) WIDEBAND AT 1.0 kHz**
- **COMPLEMENTARY TO 2N5209 • 2N5210**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	-55° C to +135° C
Operating Junction Temperature	-55° C to +135° C
†Lead Temperature (Soldering, 10 seconds time limit)	+230° C

Maximum Power Dissipation (Notes 2 and 3)

†Total Dissipation at 25° C Ambient Temperature	0.31 Watt

Maximum Voltages and Current

†V_{CBO}	Collector to Base Voltage	-50 Volts
†V_{CEO}	Collector to Emitter Voltage (Note 4)	-50 Volts
†V_{EBO}	Emitter to Base Voltage	-3.0 Volts
I_C	Collector Current (peak)	100 mA
†I_C	Collector Current (continuous)	50 mA

ELECTRICAL CHARACTERISTICS (25° C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5086 MIN.	2N5086 TYP.	2N5086 MAX.	2N5087 MIN.	2N5087 TYP.	2N5087 MAX.	UNITS	TEST CONDITIONS
†$BV_{CEO(sat)}$	**Collector to Emitter Sustaining Voltage**	**-50**			**-50**			**Volts**	**I_C = 1.0 mA, I_B = 0**
†BV_{CBO}	Collector to Base Breakdown Voltage	-50			-50			Volts	I_C = 100 μA, I_E = 0
I_{CBO}	Collector Cutoff Current			10			10	nA	V_{CB} = -10 V, I_E = 0
†I_{CBO}	Collector Cutoff Current			50			50	nA	V_{CB} = -35 V, I_E = 0
†I_{EBO}	Emitter Cutoff Current			50			50	nA	V_{EB} = -3.0 V, I_C = 0
†h_{FE}	**DC Current Gain**	150		500	**250**		800		**I_C = 100 μA, V_{CE} = -5.0 V**
†h_{FE}	**DC Current Gain**	150			**250**				**I_C = 1.0 mA, V_{CE} = -5.0 V**
†h_{FE}	**DC Pulse Current Gain (Note 5)**	150			**250**				**I_C = 10 mA, V_{CE} = -5.0 V**
†$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)			-0.3			-0.3	Volt	I_C = 10 mA, I_B = 1.0 mA
†$V_{BE(on)}$	Emitter to Base On Voltage (Note 5)			-0.85			-0.85	Volt	I_C = 1.0 mA, V_{CE} = -5.0 V
†f_T	Current Gain Bandwidth Product (f = 20 MHz)	40	120		40	150		MHz	I_C = 500 μA, V_{CE} = -5.0 V
†C_{cb}	Output Capacitance (f = 100 kHz)			4.0			4.0	pF	V_{CB} = -5.0 V, I_E = 0
†h_{fe}	Small Signal Current Gain (f=1.0 kHz)	150		600	250		900		I_C = 1.0 mA, V_{CE} = -5.0 V
†NF	Noise Figure (f=10 Hz to 15.7 kHz)			3.0			2.0	dB	I_C = 20 μA, V_{CE} = -5.0 V, R_S = 10 kΩ
†NF	**Noise Figure (f = 1.0 kHz)**		1.2	**3.0**		1.0	**2.0**	**dB**	**I_C = 100 μA, V_{CE} = -5.0 V, R_S = 3.0 kΩ**

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

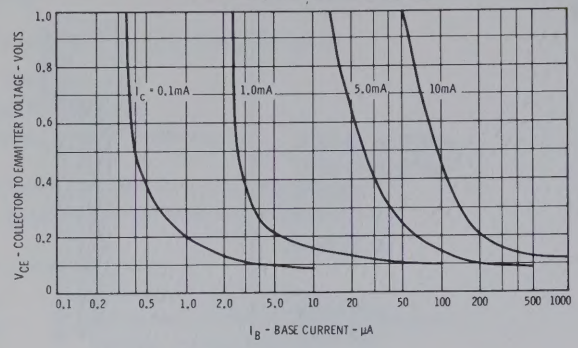
(3) These ratings give a maximum junction temperature of 135° C and junction to ambient thermal resistance of 357° C/Watt (derating factor of 2.81 mW/° C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

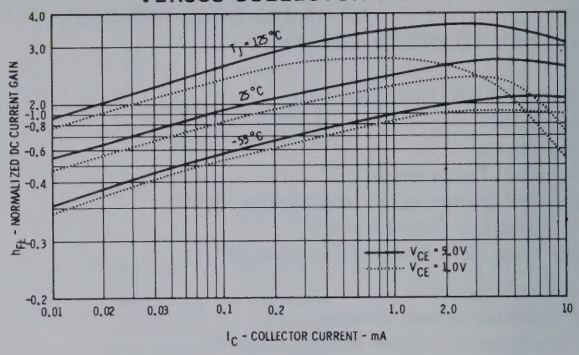
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

TYPICAL ELECTRICAL CHARACTERISTICS

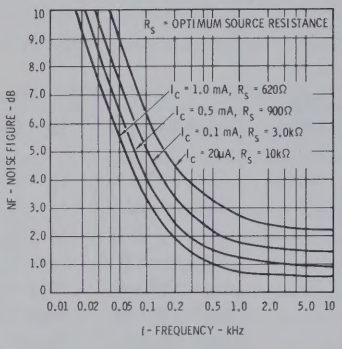
COLLECTOR TO EMITTER VOLTAGE VERSUS BASE CURRENT



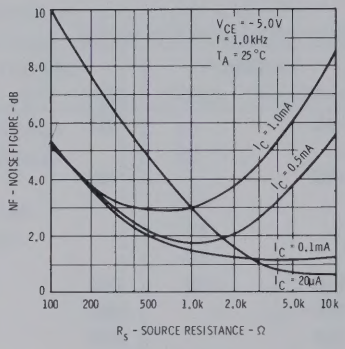
NORMALIZED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



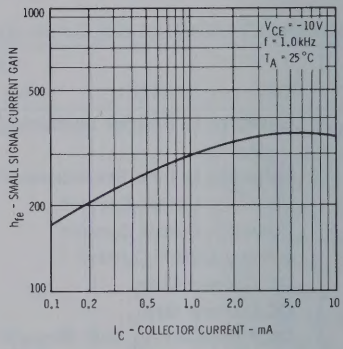
NOISE FIGURE VERSUS FREQUENCY


R_S = OPTIMUM SOURCE RESISTANCE
I_C = 1.0 mA, R_S = 620Ω
I_C = 0.5 mA, R_S = 900Ω
I_C = 0.1 mA, R_S = 3.0kΩ
I_C = 20μA, R_S = 10kΩ
NF - NOISE FIGURE - dB
f - FREQUENCY - kHz

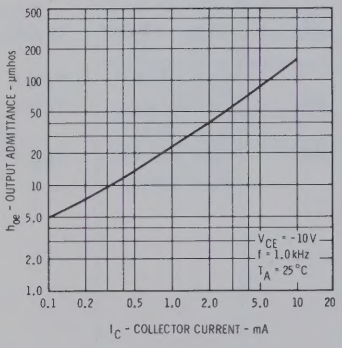
NOISE FIGURE VERSUS SOURCE RESISTANCE



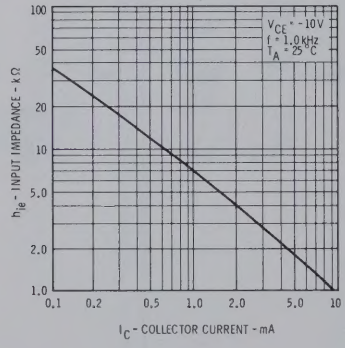
SMALL SIGNAL CURRENT GAIN VERSUS COLLECTOR CURRENT



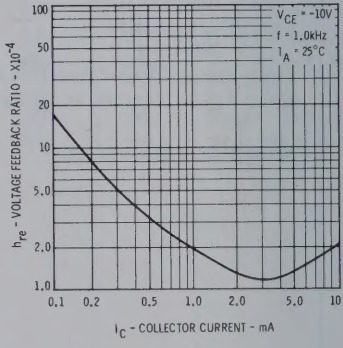
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT



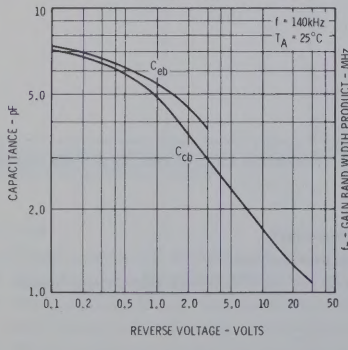
INPUT IMPEDANCE VERSUS COLLECTOR CURRENT



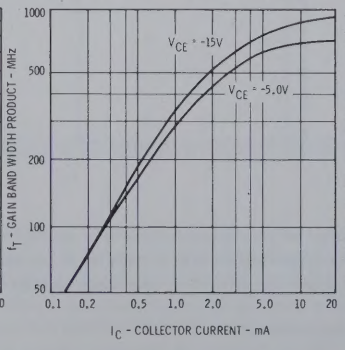
VOLTAGE FEEDBACK RATIO VERSUS COLLECTOR CURRENT



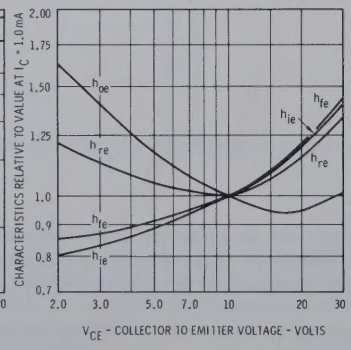
CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



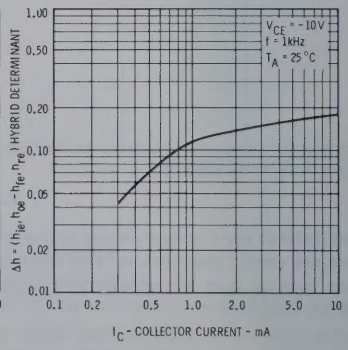
GAIN BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



h PARAMETERS VERSUS VOLTAGE



HYBRID DETERMINANT VERSUS COLLECTOR CURRENT

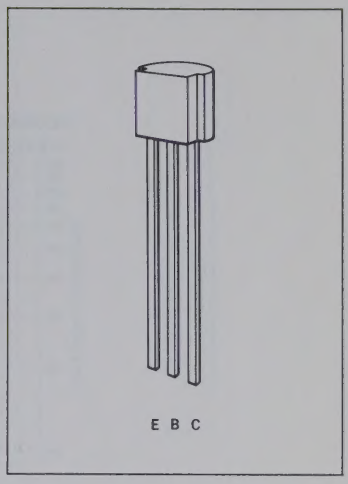


2N5088 • 2N5089

NPN LOW LEVEL, LOW NOISE, HIGH GAIN AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH GAIN . . . . h_{FE} = 400 (MIN) FROM 100 μA TO 10 mA**
- **LOW NOISE . . . . NF = 2.0 dB (MAX) WIDEBAND AT 100 μA**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperature

†Storage Temperature	−55°C to +135°C
Operating Junction Temperature	−55°C to +135°C
†Lead Temperature (Soldering, 10 seconds time limit)	+230°C

Maximum Power Dissipation (Notes 2 and 3)

†Total Dissipation at 25°C Ambient Temperature	0.31 Watt

Maximum Voltages and Current

		2N5088	2N5089
†V_{CBO}	Collector to Base Voltage	35 Volts	30 Volts
†V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts	25 Volts
†V_{EBO}	Emitter to Base Voltage	4.5 Volts	4.5 Volts
†I_C	Collector Current	50 mA	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5088 MIN.	2N5088 TYP.	2N5088 MAX.	2N5089 MIN.	2N5089 TYP.	2N5089 MAX	UNITS	TEST CONDITIONS
$BV_{CEO(sat)}$	**Collector to Emitter Sustaining Voltage**	30			25			Volts	I_C = 1.0 mA, I_E = 0
†BV_{CBO}	Collector to Base Breakdown Voltage	35			30			Volts	I_C = 100 μA, I_E = 0
†I_{CBO}	Collector Cutoff Current			50				nA	V_{CB} = 20 V, I_E = 0
†I_{CBO}	Collector Cutoff Current						50	nA	V_{CB} = 15 V, I_E = 0
†I_{EBO}	Emitter Cutoff Current			50			50	nA	$V_{EB(off)}$=3.0 V, I_C = 0
I_{EBO}	Emitter Cutoff Current			100			100	na	$V_{EB(off)}$ = 4.5V, I_C = 0
†h_{FE}	**DC Current Gain**	300		900	**400**		1200		**I_C = 100 μA, V_{CE} = 5.0 V**
†h_{FE}	**DC Current Gain**	350			**450**				**I_C = 1.0 mA, V_{CE} = 5.0 V**
†h_{FE}	**DC Current Gain (Note 5)**	300			**400**				**I_C = 10 mA, V_{CE} = 5.0 V**
†$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)			0.5			0.5	Volts	I_C = 10 mA, I_B = 1.0 mA
†$V_{BE(on)}$	Base to Emitter On Voltage (Note 5)			0.8			0.8	Volts	I_C = 10 mA, V_{CE} = 5.0 V
f_T	Current Gain Bandwidth Product (f = 20 MHz)	50	175		50	175		MHz	I_C = 500 μA, V_{CE} = 5.0 V
†C_{cb}	Collector to Base Capacitance (f = 100 kHz)		1.8	4.0		1.8	4.0	pF	V_{CB} = 5.0 V, I_E = 0
C_{eb}	Emitter to Base Capacitance (f = 100 kHz)		4.0	10		4.0	10	pF	V_{BE} = 0.5 V, I_C = 0
†h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	350		1400	450		1800		I_C = 1.0 mA, V_{CE} = 5.0 V
†NF	**Noise Figure (f = 10 Hz to 15.7 kHz)**			**3.0**			**2.0**	**dB**	**I_C = 100 μA, V_{CE} = 5.0 V R_S = 10 kΩ**

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

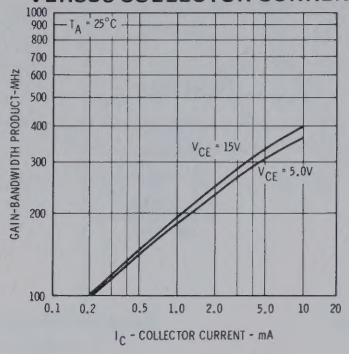
(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

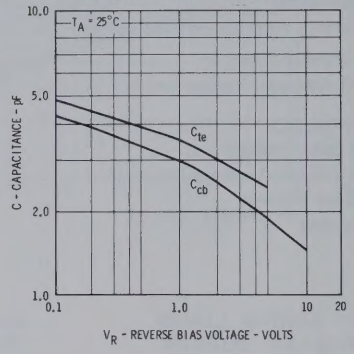
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

TYPICAL ELECTRICAL CHARACTERISTICS

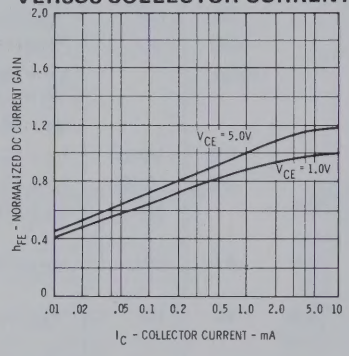
NORMALIZED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



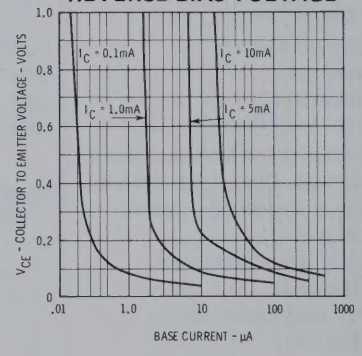
COLLECTOR TO EMITTER VOLTAGE VERSUS BASE CURRENT



GAIN-BANDWIDTH PRODUCT VERSUS COLLECTOR CURRENT



CAPACITANCE VERSUS REVERSE BIAS VOLTAGE

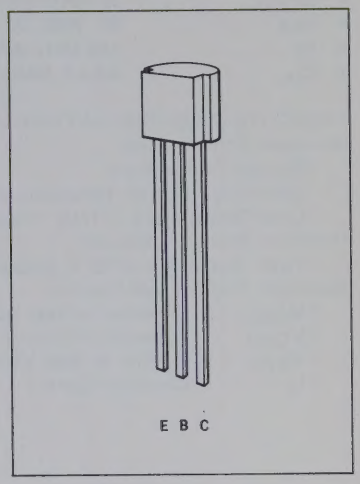


2N5209 • 2N5210

NPN LOW LEVEL, LOW NOISE, HIGH GAIN AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH VOLTAGE . . . . . V_{CEO} = 50 V (MIN)**
- **HIGH GAIN . . . . . h_{FE} = 200 (MIN) AT 100 μA**
  . . . . . h_{FE} = 250 (MIN) AT 1.0 mA AND 10 mA
- **LOW NOISE . . . . . NF = 2.0 dB (MAX) AT WIDEBAND**
- **COMPLEMENTARY TO 2N5086 • 2N5087**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	-55°C to +135°C
†Operating Junction Temperature	-55°C to +135°C

Maximum Power Dissipation (Notes 2 and 3)

†Total Dissipation at 25°C Ambient Temperature	0.31 W

Maximum Voltages and Current

†V_{CBO}	50 Volts
†V_{CEO}	50 Volts
†V_{EBO}	4.5 Volts
†I_C	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
†BV_{CEO}	Collector to Emitter Breakdown Voltage	50			50			Volts	I_C = 1.0 mA, I_B = 0
†BV_{CBO}	Collector to Base Breakdown Voltage	50			50			Volts	I_C = 100 μA, I_E = 0
I_{CBO}	Collector Cutoff Current			10			10	nA	V_{CB} = 10 V, I_E = 0
†I_{CBO}	Collector Cutoff Current			50			50	nA	V_{CB} = 35 V, I_E = 0
†I_{EBO}	Emitter Cutoff Current			50			50	nA	V_{EB} = 3.0 V, I_C = 0
I_{EBO}	Emitter Cutoff Current			100			100	nA	V_{EB} = 4.5 V, I_C = 0
†h_{FE}	**DC Current Gain**	100		300	**200**		**600**		**I_C = 100 μA, V_{CE} = 5.0 V**
†h_{FE}	**DC Current Gain**	150			**250**				**I_C = 1.0 mA, V_{CE} = 5.0 V**
†h_{FE}	**DC Current Gain**	150			**250**				**I_C = 10 mA, V_{CE} = 5.0 V**
†$V_{CE(sat)}$	Collector Saturation Voltage			0.7			0.7	Volts	I_C = 10 mA, I_B = 1.0 mA
†$V_{BE(on)}$	Base to Emitter On Voltage			0.85			0.85	Volts	I_C = 10 mA, V_{CE} = 5.0 V
†f_T	Current Gain Bandwidth Product (f = 20 MHz)	30			30			MHz	I_C = 500 μA, V_{CE} = 5.0 V
†C_{cb}	Collector to Base Capacitance (f = 100 kHz)			4.0			4.0	pF	V_{CB} = 5.0 V, I_E = 0
†h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	150		600	250		900		I_C = 1.0 mA, V_{CE} = 5.0 V
†**NF**	**Noise Figure (f=10 Hz to 15.7 kHz)**			3.0			**2.0**	**dB**	**I_C = 20 μA, V_{CE} = 5.0 V R_S = 22 kΩ**
†NF	Noise Figure (f = 1.0 kHz)		1.6	4.0		1.4	3.0	dB	I_C = 20 μA, V_{CE} = 5.0 V R_S = 10 kΩ

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

2N5219 • 2N5223

NPN GENERAL PURPOSE AMPLIFIERS AND OSCILLATORS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} . . . . . 15 AND 20 V (MIN)
- h_{FE} . . . . . 35 - 500; 50 - 800 AT 2.0 mA
- f_T . . . . . 150 MHz (MIN) AT 10 mA
- C_{cb} . . . . . 4.0 pF (MAX)

E B C

ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	-55°C to +135°C
Operating Junction Temperature	-55°C to +135°C
†Lead Temperature (>1/16" from case; 60 second time limit)	+230°C

Maximum Power Dissipation

†Total Dissipation at 25°C Ambient Temperature (Notes 2 and 3)	0.31 Watt

Maximum Voltages and Current

		2N5219	2N5223
†V_{CBO}	Collector to Base Voltage	20 Volts	25 Volts
†V_{CEO}	Collector to Emitter Voltage	15 Volts	20 Volts
†V_{EBO}	Emitter to Base Voltage	3.0 Volts	3.0 Volts
†I_C	Collector Current	100 mA	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5219 MIN.	2N5219 MAX.	2N5223 MIN.	2N5223 MAX.	UNITS	TEST CONDITIONS
†BV_{CEO}	Collector to Emitter Breakdown Voltage	15		20		Volts	I_C = 1.0 mA, I_B = 0
†BV_{CBO}	Collector to Base Breakdown Voltage	20		25		Volts	I_C = 100 μA, I_E = 0
†BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		3.0		Volts	I_E = 100 μA, I_C = 0
†I_{CBO}	Collector Cutoff Current		100		100	nA	V_{CB} = 10 V, I_E = 0
†I_{EBO}	Emitter Cutoff Current		500			nA	V_{EB} = 2.0V, I_C = 0
I_{EBO}	Emitter Cutoff Current				500	nA	V_{EB} = 3.0 V, I_C = 0
†h_{FE}	DC Current Gain	35	500	50	800		I_C = 2.0 mA, V_{CE} = 10 V
†$V_{CE(sat)}$	Collector Saturation Voltage		0.4		0.7	Volt	I_C = 10 mA, I_B = 1.0 mA
†$V_{BE(sat)}$	Base Saturation Voltage		1.0		1.2	Volt	I_C = 10 mA, I_B = 1.0 mA
†f_T	Current Gain Bandwidth Product (f = 100 MHz)	150		150		MHz	I_C = 10 mA, V_{CE} = 10 V
†C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		4.0		4.0	pF	V_{CB} = 10 V, I_E = 0
†h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	35	1500	50	1600		I_C = 2.0 mA, V_{CE} = 10 V

†JEDEC Registered Values

*Planar is a patented Fairchild process

(NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

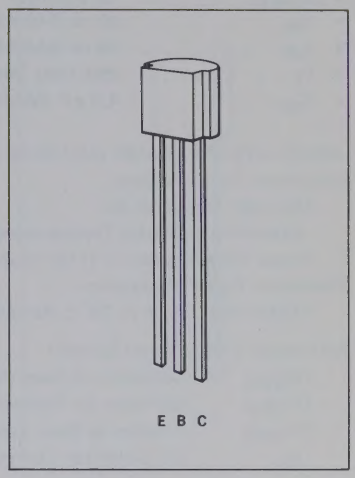
(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/°C).

2N5220 • 2N5221

NPN-PNP GENERAL PURPOSE COMPLEMENTARY AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} . . . . . 15 V (MIN)
- h_{FE} . . . . . 30 - 600 AT 50 mA
- $V_{CE(sat)}$ . . . . . 0.5 V (MAX) AT 150 mA
- COMPLEMENTARY PAIR 2N5220 (NPN) • 2N5221 (PNP)



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	−55°C to +135°C
Operating Junction Temperature	−55°C to +135°C
†Lead Temperature (>1/16" from case; 60 second time limit)	+230°C

Maximum Power Dissipation

†Total Dissipation at 25°C Ambient Temperature (Notes 2 and 3)	0.31 Watt

Maximum Voltages and Current

		2N5220	2N5221
†V_{CBO}	Collector to Base Voltage	15 Volts	−15 Volts
†V_{CEO}	Collector to Emitter Voltage	15 Volts	−15 Volts
†V_{EBO}	Emitter to Base Voltage	3.0 Volts	−3.0 Volts
†I_C	Collector Current	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5220 MIN.	2N5220 MAX.	2N5221 MIN.	2N5221 MAX.	UNITS	TEST CONDITIONS (Reverse Voltage Polarity For PNP)	
†BV_{CEO}	Collector to Emitter Breakdown Voltage	15		−15		Volts	I_C = 10 mA,	I_B = 0
†BV_{CBO}	Collector to Base Breakdown Voltage	15		−15		Volts	I_C = 100 μA,	I_E = 0
†BV_{EBO}	Emitter to Base Breakdown Voltage	3.0		−3.0		Volts	I_E = 100 μA,	I_C = 0
†I_{CBO}	Collector Cutoff Current		100		100	nA	V_{CB} = 10 V,	I_E = 0
†I_{EBO}	Emitter Cutoff Current		100		100	nA	V_{EB} = 3.0 V,	I_C = 0
†h_{FE}	DC Current Gain	25		25			I_C = 10 mA,	V_{CE} = 10 V
†h_{FE}	DC Current Gain	30	600	30	600		I_C = 50 mA,	V_{CE} = 10 V
†$V_{CE(sat)}$	Collector Saturation Voltage		0.5		−0.5	Volts	I_C = 150 mA,	I_B = 15 mA
†$V_{BE(sat)}$	Base Saturation Voltage		1.1		−1.1	Volts	I_C = 150 mA,	I_B = 15 mA
†f_T	Current Gain Bandwidth Product	100		100		MHz	I_C = 20 mA,	V_{CE} = 10 V
†C_{cb}	Collector to Base Capacitance (f=1.0 MHz)		10		15	pF	V_{CB} = 5.0 V,	I_E = 0
†h_{fe}	Small Signal Current Gain (f=1.0 kHz)	30	1800	30	1800		I_C = 50 mA,	V_{CE} = 10 V

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low cuty cycle operations.

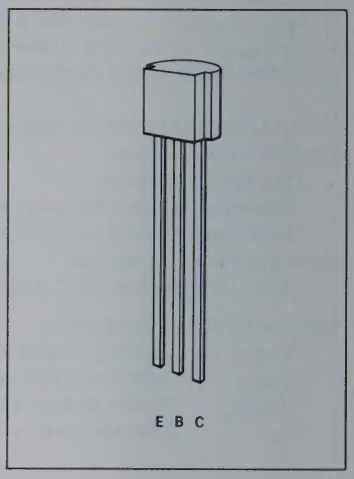
(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/°C).

2N5224

NPN LOW LEVEL SWITCH

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- V_{CEO} . . . . . 12 V (MIN)
- t_{on} . . . . . 45 ns (MAX) AT 10 mA
- t_{off} . . . . . 60 ns (MAX) AT 10 mA
- f_T . . . . . 250 MHz (MIN) AT 10 mA
- C_{cb} . . . . . 4.0 pF (MAX)



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	−55°C to +135°C
Operating Junction Temperature	−55°C to +135°C
†Lead Temperature (>1/16" from case; 60 second time limit)	+230°C

Maximum Power Dissipation

†Total Dissipation at 25°C Ambient Temperature (Notes 2 and 3)	0.31 Watt

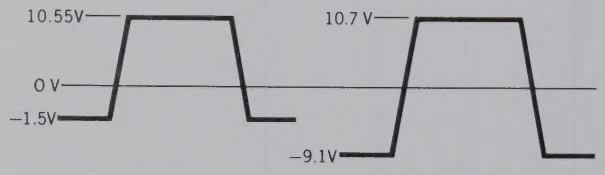
Maximum Voltages and Current

†V_{CBO}	Collector to Base Voltage	25 Volts
†V_{CEO}	Collector to Emitter Voltage	12 Volts
†V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	DC Collector Current	100 mA

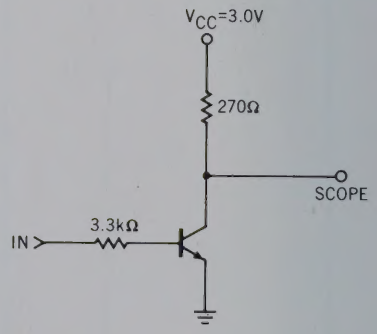
ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
†BV_{CEO}	Collector to Emitter Breakdown Voltage	12		Volts	I_C = 10 mA, I_B = 0
†BV_{CBO}	Collector to Base Breakdown Voltage	25		Volts	I_C = 100 μA, I_E = 0
†BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		Volts	I_E = 100 μA, I_C = 0
†I_{CBO}	Collector Cutoff Current		500	nA	V_{CB} = 15 V, I_E = 0
†I_{EBO}	Emitter Cutoff Current		100	μA	V_{EB} = 4.0 V, I_C = 0
†h_{FE}	DC Current Gain	40	400		I_C = 10 mA, V_{CE} = 1.0 V
†h_{FE}	DC Current Gain	15			I_C = 100 mA, V_{CE} = 1.0 V
†$V_{CE(sat)}$	Collector Saturation Voltage		0.35	Volts	I_C = 10 mA, I_B = 3.0 mA
†$V_{BE(sat)}$	Base Saturation Voltage		0.9	Volts	I_C = 10 mA, I_B = 3.0 mA
†f_T	Current Gain Bandwidth Product (f=100 MHz)	250		MHz	I_C = 10 mA, V_{CE} = 10 V
†C_{cb}	Collector to Base Capacitance (f=1.0 MHz)		4.0	pF	V_{CB} = 5.0 V, I_E = 0
†t_d	Delay Time (Figure 1)		25	ns	$I_C \approx$ 10 mA, $I_{B1} \approx$ 3.0 mA
†t_r	Rise Time (Figure 1)		20	ns	$I_C \approx$ 10 mA, $I_{B1} \approx$ 3.0 mA
†t_s	Storage Time (Figure 1)		35	ns	$I_C \approx$ 10 mA, $I_{B1} \approx -I_{B2} \approx$ 3.0 mA
†t_f	Fall Time (Figure 1)		25	ns	$I_C \approx$ 10 mA, $I_{B1} \approx -I_{B2} \approx$ 3.0 mA

FIGURE 1 – SWITCHING TIME TEST CIRCUIT



TURN-ON INPUT PULSE TURN-OFF INPUT PULSE



GENERATOR SOURCE IMPEDANCE = 50 ohms

INPUT PULSE:
- Rise Time ≤ 2.0 ns
- Fall Time ≤ 2.0 ns
- Nominal Pulsewidth = 300 ns
- Nominal Duty Cycle = 2.0%

OSCILLOSCOPE:
- Rise Time ≤ 0.4 ns
- Input Resistance ≥ 50 ohms
- Input Capacitance ≤ 4.0 pF

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

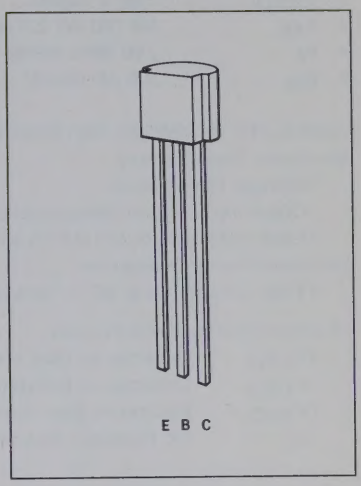
(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/°C).

2N5225 • 2N5226

NPN-PNP GENERAL PURPOSE COMPLEMENTARY AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} . . . . . 25 V (MIN)
- h_{FE} . . . . . 30 - 600 AT 50 mA
- $V_{CE(sat)}$ . . . . . 0.8 V (MAX) AT 150 mA
- COMPLEMENTARY PAIR 2N5225 (NPN) • 2N5226 (PNP)



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	-55°C to +135°C
Operating Junction Temperature	-55°C to +135°C
†Lead Temperatre (>1/16" from case; 60 second time limit)	+230°C

Maximum Power Dissipation

†Total Dissipation at 25°C Ambient Temperature (Notes 2 and 3)	0.31 Watt

Maximum Voltages and Current

		2N5225	2N5226
†V_{CBO}	Collector to Base Voltage	25 Volts	-25 Volts
†V_{CEO}	Collector to Emitter Voltage	25 Volts	-25 Volts
†V_{EBO}	Emitter to Base Voltage	4.0 Volts	-4.0 Volts
†I_C	Collector Current	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5225 MIN.	2N5225 MAX.	2N5226 MIN.	2N5226 MAX.	UNITS	TEST CONDITIONS (Reverse Voltage Polarity For PNP)	
†BV_{CEO}	Collector to Emitter Breakdown Voltage	25		-25		Volts	I_C = 10 mA,	I_B = 0
†BV_{CBO}	Collector to Base Breakdown Voltage	25		-25		Volts	I_C = 100 μA,	I_E = 0
†BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		-4.0		Volts	I_E = 100 μA,	I_C = 0
†I_{CBO}	Collector Cutoff Current		300		300	nA	V_{CB} = 15 V,	I_E = 0
†I_{EBO}	Emitter Cutoff Current		500		500	nA	V_{EB} = 4.0 V,	I_C = 0
†h_{FE}	DC Current Gain	25		25			I_C = 10 mA,	V_{CE} = 10 V
†h_{FE}	DC Current Gain	30	600	30	600		I_C = 50 mA,	V_{CE} = 10 V
†$V_{CE(sat)}$	Collector Saturation Voltage		0.8		-0.8	Volt	I_C = 100 mA,	I_B = 10 mA
†$V_{BE(sat)}$	Base Saturation Voltage		1.0		-1.0	Volt	I_C = 100 mA,	I_B = 10 mA
†f_T	Current Gain Bandwith Product (f=20 MHz)	50		50		MHz	I_C = 20 mA,	V_{CE} = 10 V
†C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		20		20	pF	V_{CB} = 5.0 V,	I_E = 0
†h_{fe}	Small Signal Current Gain (f=1.0 kHz)	30	1800	30	1800		I_C = 50 mA,	V_{CE} = 10 V

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

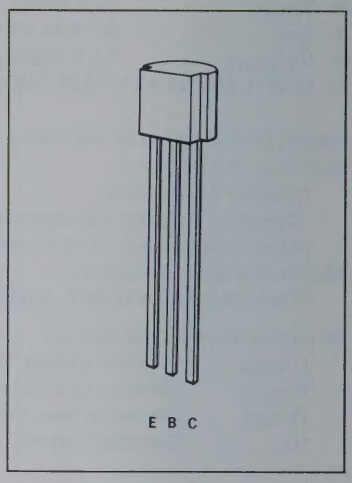
(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/°C).

2N5227

PNP GENERAL PURPOSE AMPLIFIER AND OSCILLATOR

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- V_{CEO} . . . −30 V (MIN)
- h_{FE} . . . . . 50-700 AT 2.0 mA
- f_T . . . . . 100 MHz (MIN) AT 10 mA
- C_{cb} . . . . . 5.0 pF (MAX)



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	−55°C to +135°C
Operating Junction Temperature	−55°C to +135°C
†Lead Temperature (>1/16" from case; 60 second time limit)	+230°C

Maximum Power Dissipation

†Total Dissipation at 25°C Ambient Temperature (Notes 2 and 3)	0.31 W

Maximum Voltages and Current

†V_{CBO}	Collector to Base Voltage	−30 Volts
†V_{CEO}	Collector to Emitter Voltage	−30 Volts
†V_{EBO}	Emitter to Base Voltage	−3.0 Volts
I_C	DC Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
†BV_{CEO}	Collector to Emitter Breakdown Voltage	−30		Volts	I_C = 10 mA, I_B = 0
†BV_{CBO}	Collector to Base Breakdown Voltage	−30		Volts	I_C = 100 μA, I_E = 0
†BV_{EBO}	Emitter to Base Breakdown Voltage	−3.0		Volts	I_E = 100 μA, I_C = 0
†I_{CBO}	Collector Cutoff Current		100	nA	V_{CB} = −10 V, I_E = 0
†I_{EBO}	Emitter Cutoff Current		500	nA	V_{EB} = −2.0 V, I_C = 0
†h_{FE}	DC Current Gain	30			I_C = 100 μA, V_{CE} = −10 V
†h_{FE}	DC Current Gain	50	700		I_C = 2.0 mA, V_{CE} = −10 V
†$V_{CE(sat)}$	Collector Saturation Voltage		−0.4	Volts	I_C = 10 mA, I_B = 1.0 mA
†$V_{BE(sat)}$	Base Saturation Voltage		−1.0	Volt	I_C = 10 mA, I_B = 1.0 mA
†f_T	Current Gain Bandwidth Product (f = 100 MHz)	100		MHz	I_C = 10 mA, V_{CE} = −10 V
†h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	50	1500		I_C = 2.0 mA, V_{CE} = −10 V
C_{cb}	Collector to Base Capacitance		5.0	pF	V_{CB} = 10 V, I_E = 0

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

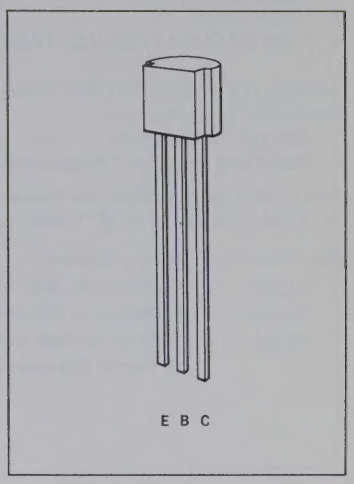
(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/°C).

2N5228

PNP LOW LEVEL SWITCH

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- V_{CEO} . . . . . −5.0 V (MIN)
- t_{on} . . . . . 75 ns (MAX AT 10 mA
- t_{off} . . . . . 140 ns (MAX) AT 10 nA
- f_T . . . . . 300 MHz (MIN) AT 10 mA
- C_{cb} . . . . . 5.0 pF (MAX)



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperature	−55°C to +135°C
Operating Junction Temperature	−55°C to +135°C
†Lead Temperature (>1/16" from case; 60 second time limit)	+230°C

Maximum Power Dissipation

†Total Dissipation at 25°C Ambient Temperature (Notes 2 and 3)	0.31 W

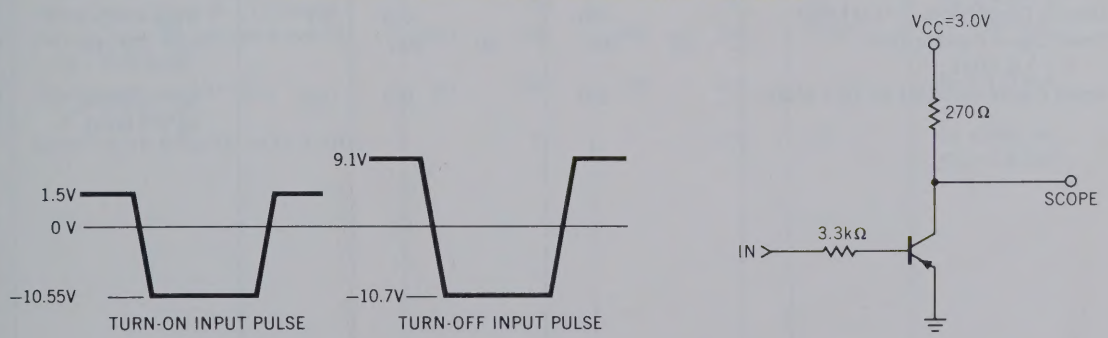
Maximum Voltages and Current

†V_{CES}	Collector to Emitter Voltage	−6.0 Volts
†V_{CBO}	Collector to Base Voltage	−5.0 Volts
†V_{CEO}	Collector to Emitter Voltage	−5.0 Volts
†V_{EBO}	Emitter to Base Voltage	−3.0 Volts
I_C	DC Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
†BV_{CEO}	Collector to Emitter Breakdown Voltage	−5.0		Volts	I_C = 10 mA, I_B = 0
†BV_{CES}	Collector to Emitter Breakdown Voltage	−6.0		Volts	I_C = 100 μA, V_{BE} = 0
†BV_{CBO}	Collector to Base Breakdown Voltage	−5.0		Volts	I_C = 100 μA, I_E = 0
†BV_{EBO}	Emitter to Base Breakdown Voltage	−3.0		Volts	I_E = 100 μA, I_C = 0
†I_{CES}	Collector Cutoff Current		100	nA	V_{CE} = −4.0 V, V_{BE} = 0
†I_{EBO}	Emitter Cutoff Current		100	μA	V_{EB} = −2.5 V, I_C = 0
†h_{FE}	DC Current Gain	30			I_C = 10 mA, V_{CE} = −0.3 V
†h_{FE}	DC Current Gain	15			I_C = 50 mA, V_{CE} = −1.0 V
†$V_{CE(sat)}$	Collector Saturation Voltage		−0.4	Volt	I_C = 10 mA, I_B = 3.0 mA
†$V_{BE(sat)}$	Base Saturation Voltage	−0.65	−1.25	Volts	I_C = 10 mA, I_B = 3.0 mA
†f_T	Current Gain Bandwidth Product (f=100 MHz)	300		MHz	I_C = 10 mA, V_{CE} = −5.0 V
†C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)		5.0	pF	V_{CB} = −5.0 V, I_E = 0
†t_d	Delay Time (Figure 1)		25	ns	$I_C \approx$ 10 mA, $I_{B1} \approx$ 3.0 mA
†t_r	Rise Time (Figure 1)		50	ns	$I_C \approx$ 10 mA, $I_{B1} \approx$ 3.0 mA
†t_s	Storage Time (Figure 1)		90	ns	$I_C \approx$ 10 mA, $I_{B1} \approx -I_{B2} \approx$ 3.0 mA
†t_f	Fall Time (Figure 1)		50	ns	$I_C \approx$ 10 mA, $I_{B1} \approx -I_{B2} \approx$ 3.0 mA

FIGURE 1 – SWITCHING TIME TEST CIRCUIT



GENERAL SOURCE IMPEDANCE = 50 ohms

INPUT PULSE:
- Rise Time ≤ 2.0 ns
- Fall Time ≤ 2.0 ns
- Nominal Pulsewidth = 300 ns
- Nominal Duty Cycle = 2.0%

OSCILLOSCOPE:
- Rise Time ≤ 0.4 ns
- Input Resistance ≥ 50 ohms
- Input Capacitance ≤ 4.0 pF

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low cuty cycle operations.

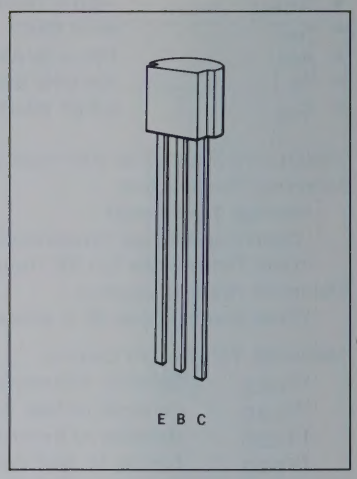
(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/°C).

2N5400 • 2N5401

PNP HIGH VOLTAGE GENERAL PURPOSE AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH VOLTAGE** . . . . . V_{CE} = −150 V (MIN)
- **HIGH GAIN** . . . . . h_{FE} = 60-240 AT 10 mA
- **LOW SATURATION VOLTAGE** . . . . $V_{CE(sat)}$ = −0.25 V(MAX) AT 50 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +135°C
Operating Junction Temperature	-55°C to +135°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Ambient Temperature	0.31 W

Maximum Voltages and Current

		2N5400	2N5401
V_{CBO}	Collector to Base Voltage	-130 Volts	-160 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-120 Volts	-150 Volts
V_{EBO}	Emitter to Base Voltage	-5.0 Volts	-5.0 Volts
I_C	Collector Current	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5400 MIN.	2N5400 MAX.	2N5401 MIN.	2N5401 MAX.	UNITS	TEST CONDITIONS
†BV_{CEO}	**Collector to Emitter Breakdown Voltage (Note 5)**	-120		**-150**		**Volts**	**I_C = 1.0 mA, I_B = 0**
†BV_{CBO}	Collector to Base Breakdown Voltage	-130		-160		Volts	I_C = 100 μA, I_E = 0
†BV_{EBO}	Emitter to Base Breakdown Voltage	-5.0		-5.0		Volts	I_E = 10 μA, I_C = 0
†I_{CBO}	Collector Cutoff Current		100			nA	V_{CB} = −100 V, I_E = 0
†I_{CBO}	Collector Cutoff Current				50	nA	V_{CB} = −120 V, I_E = 0
†I_{CBO}(100°C)	Collector Cutoff Current		100			μA	V_{CB} = −100 V, I_E = 0
†I_{CBO}(100°C)	Collector Cutoff Current				50	μA	V_{CB} = −120 V, I_E = 0
†I_{EBO}	Emitter Cutoff Current		50		50	na	V_{EB} = − 3.0 V, I_C = 0
†h_{FE}	DC Pulse Current Gain (Note 5)	30		50			I_C = 1.0 mA, V_{CE} = -5.0 V
†h_{FE}	**DC Pulse Current Gain (Note 5)**	40	180	**60**	**240**		**I_C = 10 mA, V_{CE} = -5.0 V**
†h_{FE}	DC Pulse Current Gain (Note 5)	40		50			I_C = 50 mA, V_{CE} = -5.0 V
†$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		-0.20		-0.20	Volt	I_C = 10 mA, I_B = 1.0 mA
†$V_{CE(sat)}$	**Collector Saturation Voltage (Note 5)**		-0.25		**-0.25**	**Volt**	**I_C = 50 mA, I_B = 5.0 mA**
†$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		-1.0		-1.0	Volt	I_C = 10 mA, I_B = 1.0 mA
†$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		-1.0		-1.0	Volt	I_C = 50 mA, I_B = 5.0 mA
†f_T	Current Gain Bandwidth Product (f = 100 MHz)	100	400	100	300	MHz	I_C = 10 mA, V_{CE} = -10 V
†C_{ob}	Output Capacitance (f=1.0 MHz)		6.0		6.0	pF	V_{CB} = -10 V, I_E = 0
†h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	30	200	40	200		I_C = 1.0 mA, V_{CE} = -10 V
†NF	Noise Figure (f=10 Hz to 15.7 kHz)		8.0		8.0	dB	I_C = 250 μA, V_{CE} = -5.0 V, R_s = 1.0 kΩ

†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

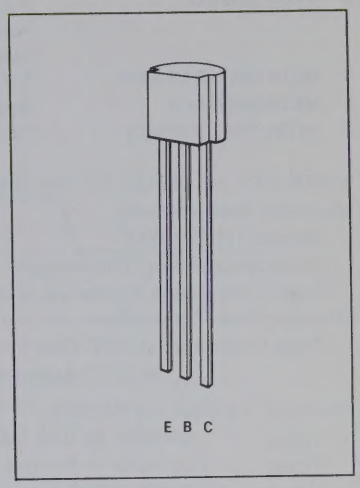
Pulse conditions: length = 300 μs; duty cycle = 2%.

2N5550 • MPS5551M

NPN HIGH VOLTAGE GENERAL PURPOSE AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH VOLTAGE** . . . . . V_{CEO} = 160 V (MIN)
- **HIGH GAIN** . . . . . h_{FE} = 80-250 AT 1.0 mA
- **LOW SATURATION VOLTAGE** . . $V_{CE}(sat)$ = 0.2 V (MAX) AT 50 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

		2N5550	MPS5551M
Maximum Temperatures			
Storage Temperature		-55°C to +135°C	-55°C to +150°C
Operating Junction Temperature		-55°C to +135°C	-55°C to +150°C
Maximum Power Dissipation (Notes 2 and 3)			
Total Dissipation at 25°C Ambient Temperature		0.31 W	0.625 W
Maximum Voltages and Current			
V_{CBO}	Collector to Base Voltage	160 Volts	180 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	140 Volts	160 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts	6.0 Volts
I_C	Collector Current	600 mA	600 mA

***ELECTRICAL CHARACTERISTICS** (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5550 MIN.	2N5550 MAX.	MPS5551M MIN.	MPS5551M MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	**Collector to Emitter Breakdown Voltage (Note 5)**	140		**160**		**Volts**	**I_C = 1.0 mA, I_B = 0**
BV_{CBO}	Collector to Base Breakdown Voltage	160		180		Volts	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		Volts	I_E = 10 μA, I_C = 0
I_{CBO}	Collector Cutoff Current		100			nA	V_{CB} = 100 V, I_E = 0
I_{CBO}	Collector Cutoff Current				50	nA	V_{CB} = 120 V, I_E = 0
$I_{CBO}(100°C)$	Collector Cutoff Current		100			μA	V_{CB} = 100 V, I_E = 0
$I_{CBO}(100°C)$	Collector Cutoff Current				50	μA	V_{CB} = 120 V, I_E = 0
I_{EBO}	Emitter Cutoff Current		50		50	nA	V_{EB} = 4.0 V, I_C = 0
h_{FE}	DC Pulse Current Gain (Note 5)	60		80			I_C = 1.0 mA, V_{CE} = 5.0 V
h_{FE}	**DC Pulse Current Gain (Note 5)**	60	250	**80**	**250**		**I_C = 10 mA, V_{CE} = 5.0 V**
h_{FE}	DC Pulse Current Gain (Note 5)	20		30			I_C = 50 mA, V_{CE} = 5.0 V
$V_{CE}(sat)$	Collector Saturation Voltage (Note 5)		0.15		0.15	Volt	I_C = 10 mA, I_B = 1.0 mA
$V_{CE}(sat)$	**Collector Saturation Voltage (Note 5)**		0.25		**0.20**	**Volt**	**I_C = 50 mA, I_B = 5.0 mA**
$V_{BE}(sat)$	Base Saturation Voltage (Note 5)		1.0		1.0	Volt	I_C = 10 mA, I_B = 1.0 mA
$V_{BE}(sat)$	Base Saturation Voltage (Note 5)		1.2		1.0	Volt	I_C = 50 mA, I_B = 5.0 mA
C_{ob}	Output Capacitance (f = 1.0 MHz)		6.0		6.0	pF	V_{CB} = 10 V, I_E = 0
C_{eb}	Input Capacitance (f = 1.0 MHz)		30		20	pF	V_{EB} = 0.5 V, I_C = 0
f_T	Current Gain Bandwidth Product (f = 100 MHz)	100	300	100	300	MHz	I_C = 10 mA, V_{CE} = 10 V
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	50	200	50	200		I_C = 1.0 mA, V_{CE} = 10 V
NF	Noise Figure (f=10 Hz to 15.7 kHz)		10		8.0	dB	I_C = 250 μA, V_{CE} = 5.0 V, R_s = 1.0 kΩ

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 135°C and junction to ambient thermal resistance of 357°C/Watt (derating factor of 2.81 mW/°C) for 2N5550; maximum junction temperature of 150°C and junction to ambient thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C) for FPS5551M.

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

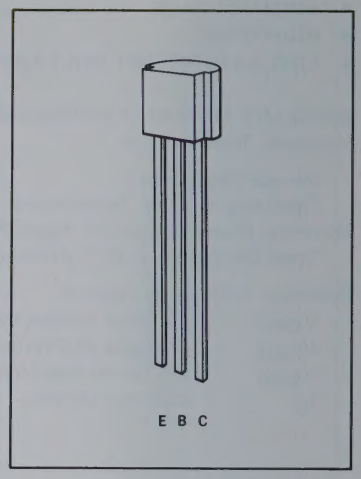
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

2N5769

NPN HIGH-SPEED SATURATED SWITCH

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH SPEED** . . . . . τ_s = 13 ns (MAX) AT 10 mA
  . . . . . t_{on} = 12 ns (MAX) AT 10 mA
  . . . . . t_{off} = 18 ns (MAX) AT 10 mA
- **MEDIUM VOLTAGE** . . . . LV_{CEO} = 15 V (MIN)
- **MEDIUM GAIN** . . . . . h_{FE} = 40 (MIN) AT 10 mA, 0.35 V
- **HIGH FREQUENCY** . . . . f_T = 500 MHz (MIN) AT 10 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	150°C Maximum
Lead Temperature (Soldering, 60 sec Time Limit)	260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.0 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	.625 Watt

Maximum Voltages and Currents

V_{CBO}	Collector to Base Voltage	40 Volts
V_{CES}	Collector to Emitter Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	4.5 Volts
I_C	Collector Current (10 μsec Pulse)	500 mA
I_C	DC Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Pulse Current Gain (Note 5)	40	66	120		I_C = 10 mA	V_{CE} = 1.0 V
h_{FE}(-55°C)	DC Pulse Current Gain (Note 5)	20	50			I_C = 10 mA	V_{CE} = 0.35 V
$V_{BE(sat)}$	Base Saturation Voltage	0.7	0.8	0.85	Volts	I_C = 10 mA	I_B = 1.0 mA
$V_{BE(sat)}$	Base Saturation Voltage (-55°C to +125°C)	0.59		1.02	Volts	I_C = 10 mA	I_B = 1.0 mA
$V_{BE(sat)}$	Base Saturation Voltage		0.9	1.15	Volts	I_C = 30 mA	I_B = 3.0 mA
$V_{BE(sat)}$	Base Saturation Voltage		1.1	1.6	Volts	I_C = 100 mA	I_B = 10 mA
$V_{CE(sat)}$	Collector Saturation Voltage (125°C)		0.19	0.3	Volts	I_C = 10 mA	I_B = 1.0 mA
I_{CES}	Collector Reverse Current		0.05	0.4	μA	V_{BE} = 0	V_{CE} = 20 V
I_{CBO}(150°C)	Collector Cutoff Current		10	30	μA	I_E = 0	V_{CB} = 20 V
BV_{CES}	Collector to Emitter Breakdown Voltage	40			Volts	I_C = 10μ A	V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	I_C = 10μ A	I_E = 0
$V_{CEO(sust)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15			Volts	I_C = 10 mA (pulsed)	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.5			Volts	I_E = 10μ A	I_C = 0
h_{FE}	DC Pulse Current Gain (Note 5)	40	63	120		I_C = 10 mA	V_{CE} = 0.35 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	71			I_C = 30 mA	V_{CE} = 0.4 V
h_{FE}	DC Pulse Current Gain (Note 5)	20				I_C = 100 mA	V_{CE} = 1.0 V
$V_{CE(sat)}$	Collector Saturation Voltage		0.14	0.2	Volts	I_C = 10 mA	I_B = 1.0 mA
$V_{CE(sat)}$	Collector Saturation Voltage		0.17	0.25	Volts	I_C = 30 mA	I_B = 3.0 mA
$V_{CE(sat)}$	Collector Saturation Voltage		0.28	0.5	Volts	I_C = 100 mA	I_B = 10 mA
h_{FE}	High Frequency Current Gain (f = 100 mc)	5.0	6.75			I_C = 10 mA	V_{CE} = 10 V
C_{ob}	Output Capacitance		2.3	4.0	pF	I_E = 0	V_{CB} = 5.0 V
	Charge Storage Time Constant (Note 6)		6.0	13	nsec	I_C = I_{B1} ≈ 10 mA,	I_{B2} ≈ -10 mA
t_{on}	Turn On Time (Note 6)		9.0	12	nsec	I_C ≈ 10 mA	I_{B1} ≈ 3.0 mA
t_{off}	Turn Off Time (Note 6)		13	18	nsec	I_C ≈ 10 mA, I_{B1} ≈ 3.0 mA, I_{B2} ≈ -1.5 mA	
I_{EBO}	Emitter to Base Curoff Current			1.0	μA	I_C = 0	V_{EB} = 4.5 V
I_{CBO}	Collector to Base Cutoff Current			0.4	μA	I_E = V_{CB} = 20 V	

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

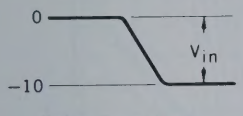
(3) These ratings give a maximum junction temperature of 150°C and junction-to-case thermal resistance of 125°C/watt (derating factor of 8.0mW/°C). Junction-to-ambient thermal resistance of 200°C/watt (derating factor of 5.0mW/°C).

(4) Rating refers to a high-current point where collector-to-emitter voltage is lowest. For more information send for Fairchild Publication APP-4.

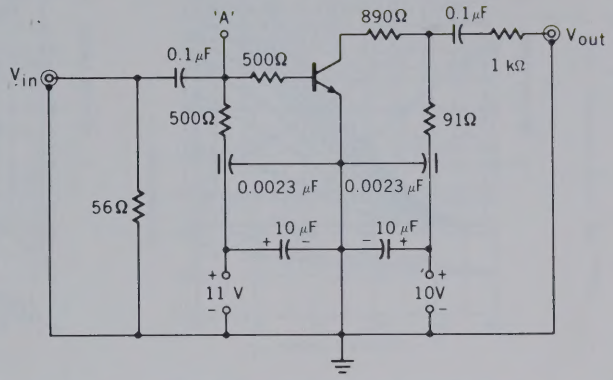
(5) Pulse Conditions: length = 300 μsec; duty cycle ≤ 2%.

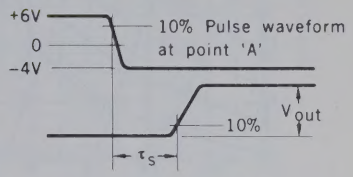
(6) See switching circuits for exact value of I_C, I_{B1}, and I_{B2}.

CHARGE STORAGE TIME MEASUREMENT CIRCUIT



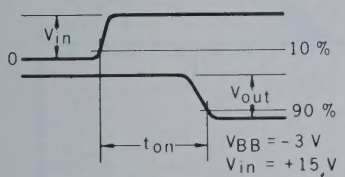
Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %



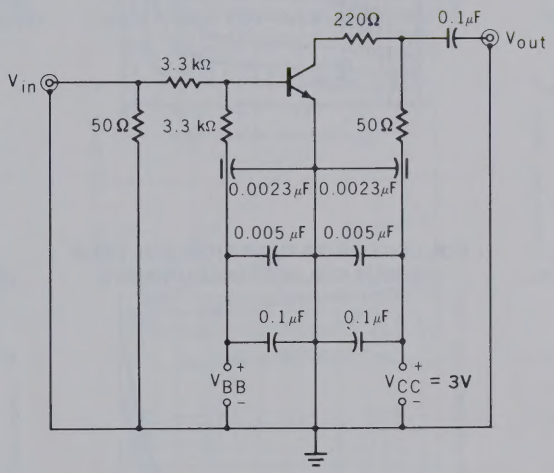


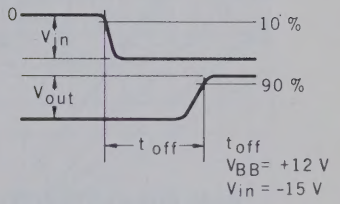
To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

$t_{ON} - t_{OFF}$ MEASUREMENT CIRCUIT



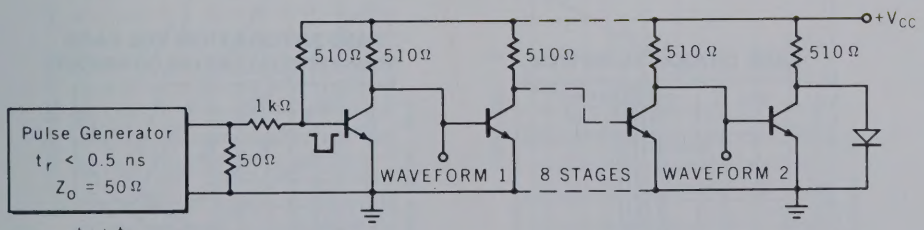
Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2 %





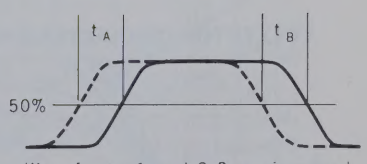
To Sampling Oscilloscope
Input Impedance = 50Ω
Rise Time ≤ 1 ns

CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY



$$\bar{t}pd = \frac{t_A + t_B}{20}$$

$\bar{t}pd$ = Average Propagation per Transistor

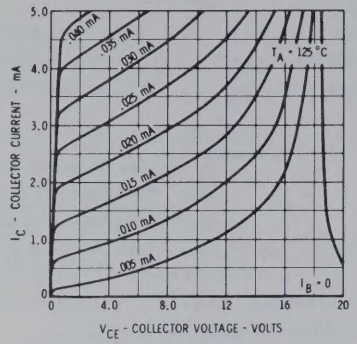


Waveforms 1 and 2 Superimposed

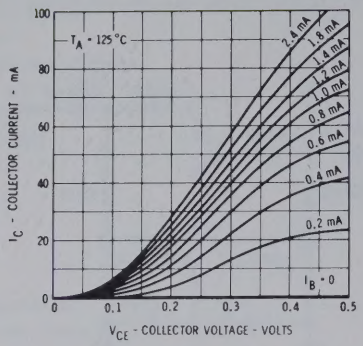
2N5769

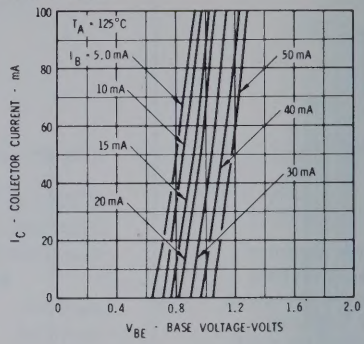
TYPICAL COLLECTOR AND BASE CHARACTERISTICS*

ACTIVE REGION

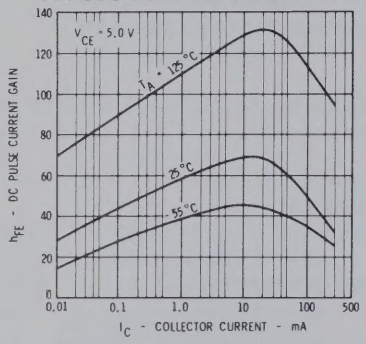


SATURATION REGION

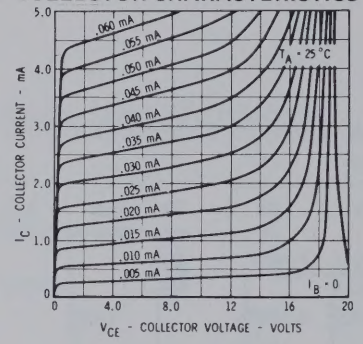




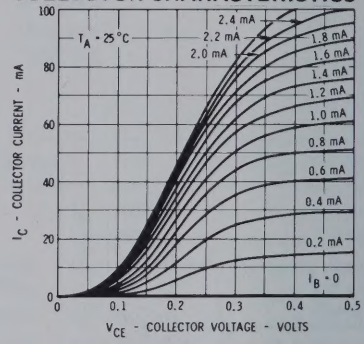
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



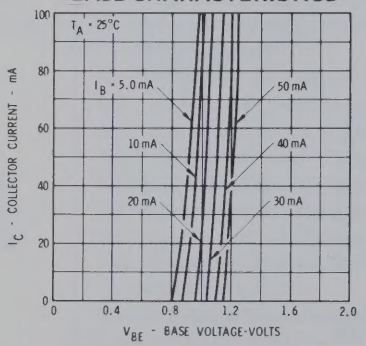
COLLECTOR CHARACTERISTICS



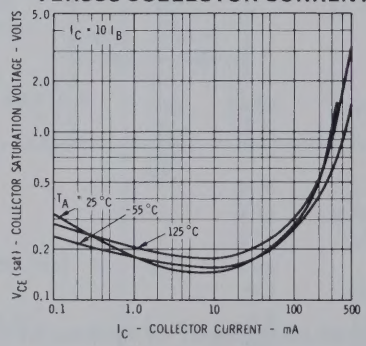
COLLECTOR CHARACTERISTICS



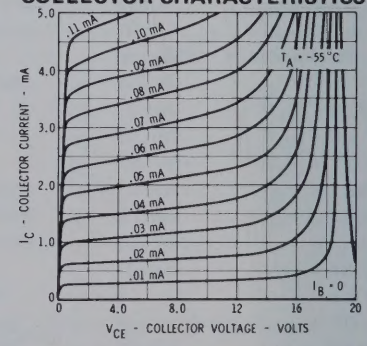
BASE CHARACTERISTICS



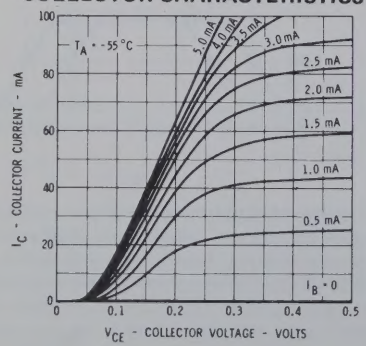
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



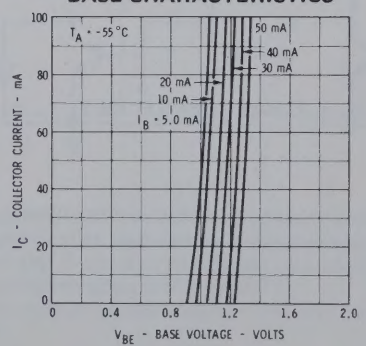
COLLECTOR CHARACTERISTICS



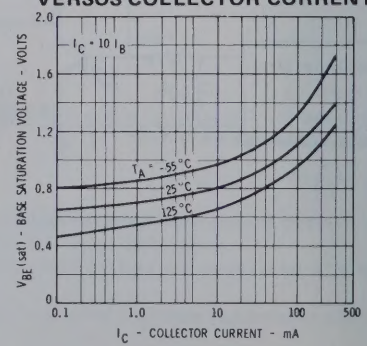
COLLECTOR CHARACTERISTICS



BASE CHARACTERISTICS

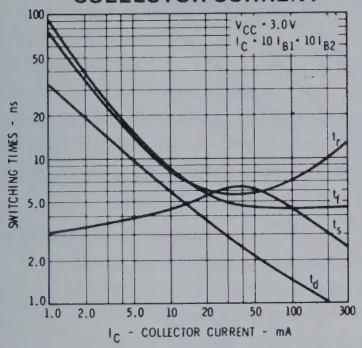


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

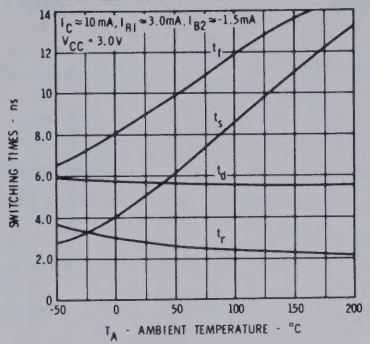


TYPICAL ELECTRICAL CHARACTERISTICS

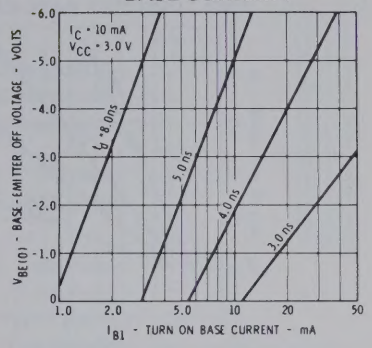
SWITCHING TIMES VERSUS COLLECTOR CURRENT



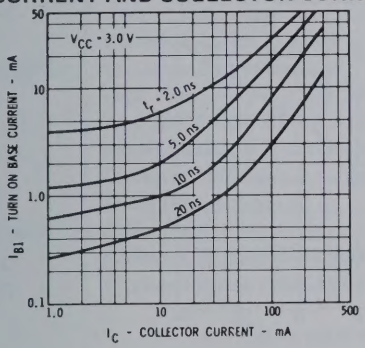
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



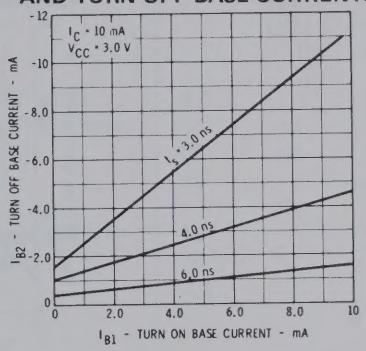
DELAY TIME VERSUS BASE-EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT



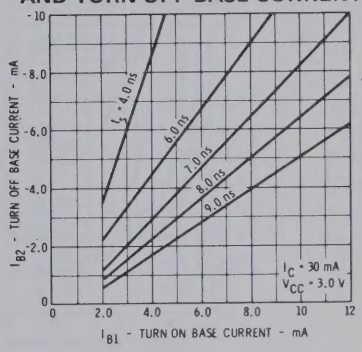
RISE TIME VERSUS TURN ON BASE CURRENT AND COLLECTOR CURRENT



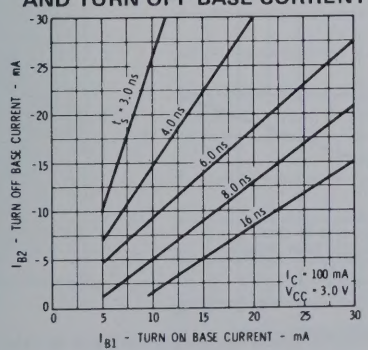
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



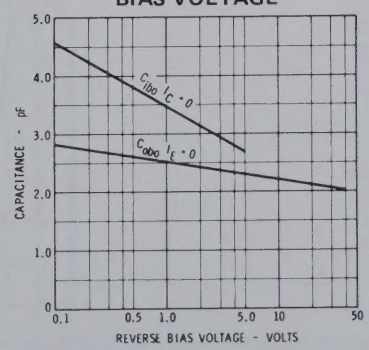
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



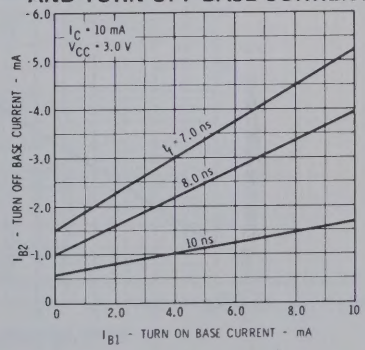
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



EMITTER TRANSITION AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE

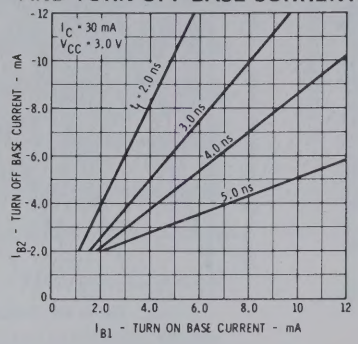


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

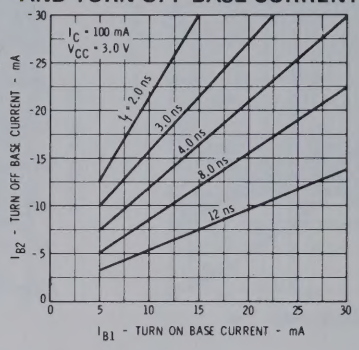


TYPICAL ELECTRICAL CHARACTERISTICS

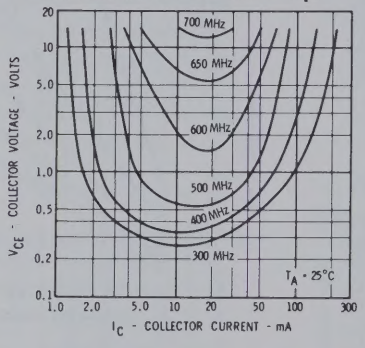
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



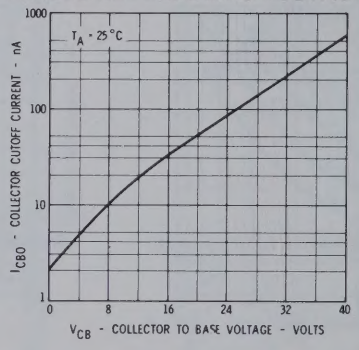
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



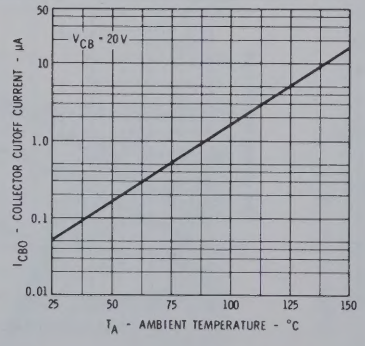
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



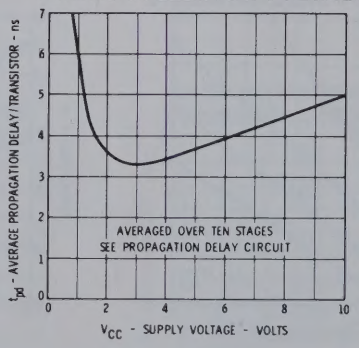
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



AVERAGE PROPAGATION DELAY PER TRANSISTOR VERSUS COLLECTOR VOLTAGE

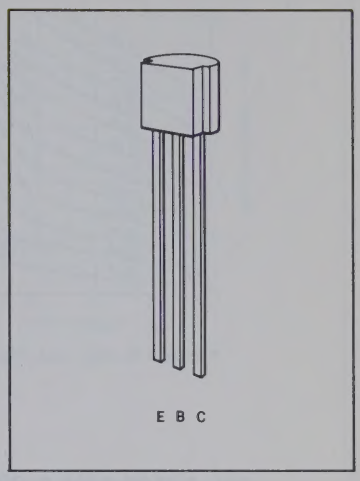

AVERAGED OVER TEN STAGES
SEE PROPAGATION DELAY CIRCUIT
t_{pd} - AVERAGE PROPAGATION DELAY / TRANSISTOR - ns
V_{CC} - SUPPLY VOLTAGE - VOLTS

2N5770

NPN ULTRA-HIGH FREQUENCY OSCILLATOR AND AMPLIFIER

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH GAIN** . . . . . G_{pe} = 15 dB (MIN) AT 200 MHz
  . . . . . P_o = 30 mW (MIN) AT 500 MHz
- **LOW CAPACITANCE** . . . . C_{cb} = 1.7 pF (MAX) AT 10 V
- **LOW NOISE** . . . . . NF = 6.0 dB (MAX) AT 60 MHz



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	150°C Maximum
Lead Temperature (Soldering, No Time Limit)	260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.0 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	.625 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts
I_C	Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25°C free air temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{FE}	DC Current Gain	20	50			I_C = 3.0 mA	V_{CE} = 1.0 V
$V_{BE(sat)}$	Base Saturation Voltage			1.0	Volts	I_C = 10 mA	I_B = 1.0 mA
$V_{CE(sat)}$	Collector Saturation Voltage			0.4	Volts	I_C = 10 mA	I_B = 1.0 mA
C_{cb}	Common-Base, Open-Circuit Output Capacitance		1.0	1.7	pF	I_E = 0	V_{CB} = 10 V
I_{EBO}	Emitter Base Cutoff Current			1.0	μA	I_C = 0	V_{EB} = 2.0 V
C_{TE}	Input Capacitance			2.0	pF	I_C = 0	V_{EB} = 0.5 V
I_{CBO}	Collector Cutoff Current			10	nA	I_E = 0	V_{CB} = 15 V
I_{CBO}(150°C)	Collector Cutoff Current			1.0	μA	I_E = 0	V_{CB} = 15 V
h_{fe}	High Frequency Current Gain (f = 100 MHz)	9.0				I_C = 8.0 mA	V_{CE} = 10 V
G_{pe}	Available Power Gain (neutralized) (f = 200 MHz)	15	18		dB	I_C = 6.0 mA	V_{CB} = 12 V
P_o	Power Output (f = 500 MHz)	30	40		mW	I_C = 8.0 mA	V_{CB} = 15 V
η	Collector Efficiency (f = 500 MHz)	25			%	I_C = 8.0 mA	V_{CB} = 15 V
NF	Noise Figure (Note 5)		3.0	6.0	dB	I_C = 1.0 mA	V_{CE} = 6.0 V
$V_{CEO(sust)}$	Collector to Emitter Sustaining Voltage (Note 4)	15			Volts	I_C = 3.0 mA	I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	I_C = 1.0 μA	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	I_C = 0	I_E = 10μA

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction-to-case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C). Junction-to-ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

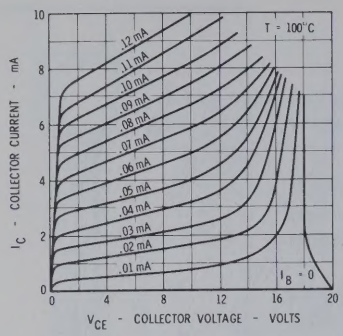
(4) Rating refers to a high current point where collector-to-emitter voltage is lowest. For more information send for Fairchild Publication APP-4.

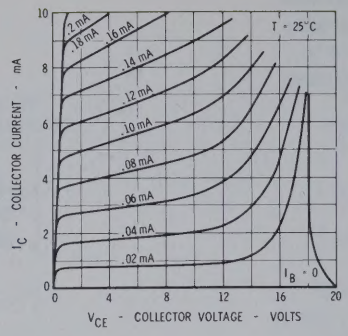
(5) f = 60 Mc; R_g = 400Ω.

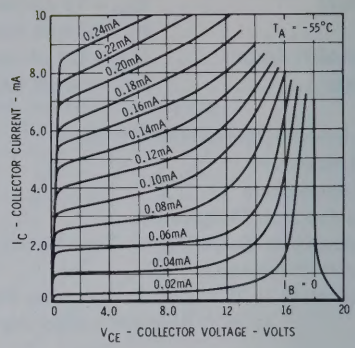
(6) C_{cb} is measured using three terminal measurement techniques with case and emitter guarded.

2N5770

TYPICAL COLLECTOR CHARACTERISTICS*



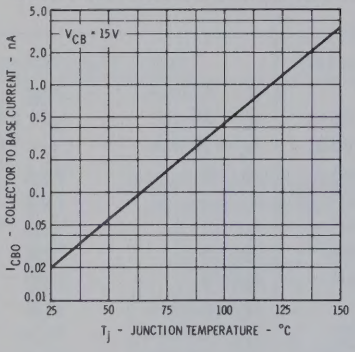




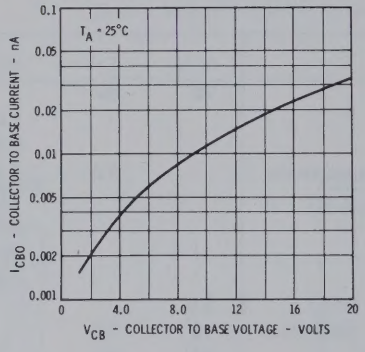
* Single family characteristics on Transistor Curve Tracer.

TYPICAL ELECTRICAL CHARACTERISTICS

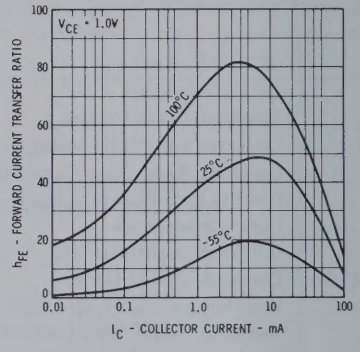
COLLECTOR-BASE DIODE REVERSE CURRENT VERSUS TEMPERATURE



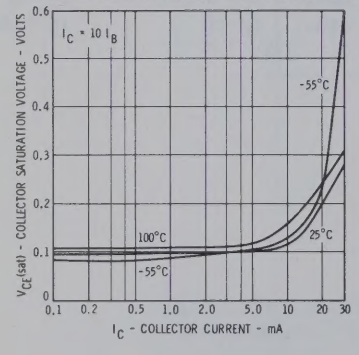
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



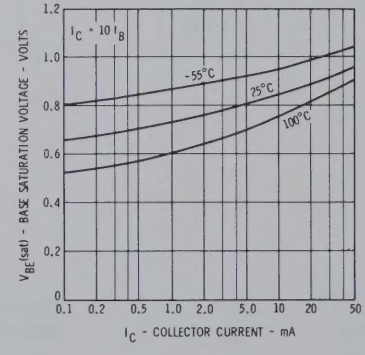
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



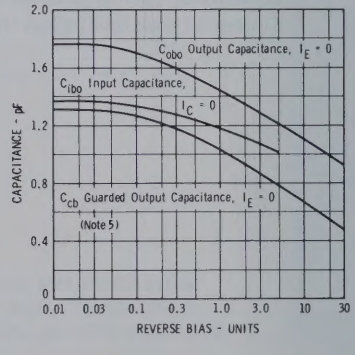
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



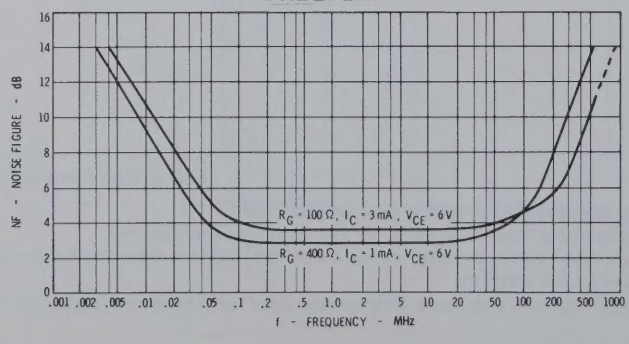
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



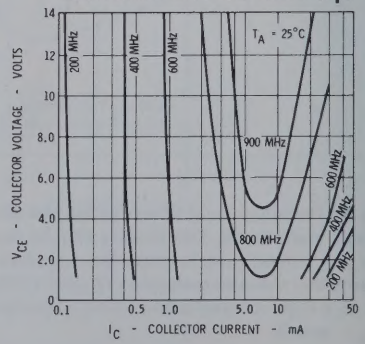
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE


C_{obo} Output Capacitance, I_E = 0
C_{ibo} Input Capacitance, I_C = 0
C_{cb} Guarded Output Capacitance, I_E = 0
(Note 5)
CAPACITANCE - pF
REVERSE BIAS - UNITS

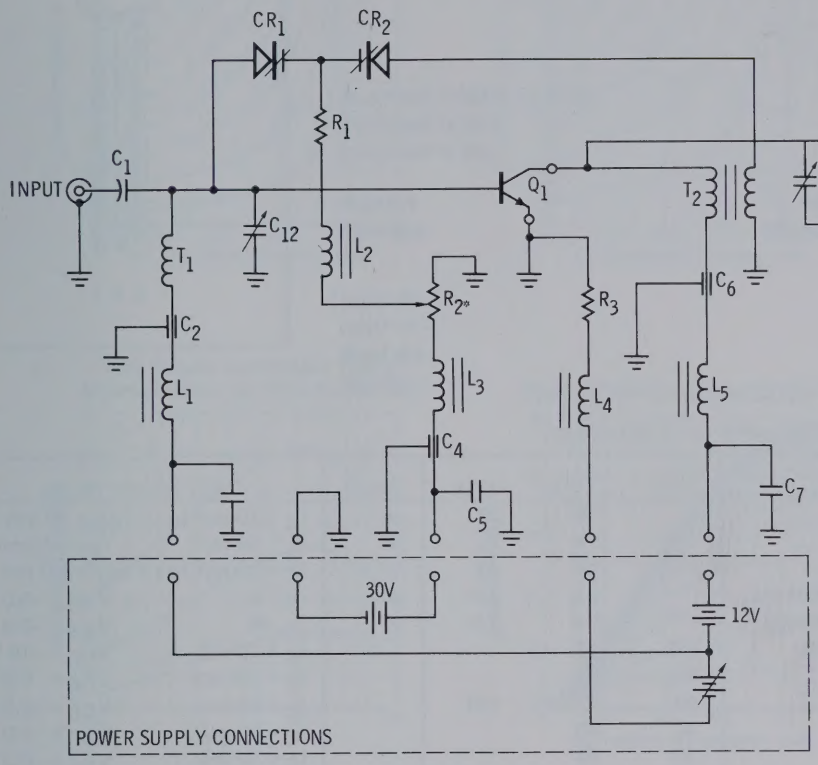
NOISE FIGURE VERSUS FREQUENCY



CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)

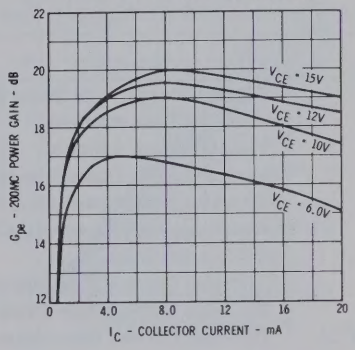


NEUTRALIZED 200MHz POWER GAIN AMPLIFIER TEST CIRCUIT

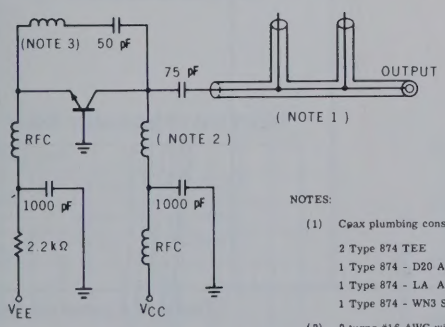


*ADJUST R_2 FOR OPTIMUM NEUTRALIZATION

TYPICAL PERFORMANCE



500MHz OSCILLATOR TEST CIRCUIT



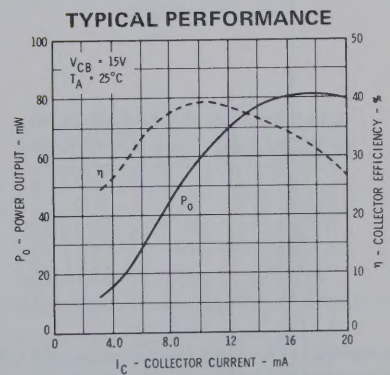
NOTES:

(1) Coax plumbing consists of the following GR air lines:
- 2 Type 874 TEE
- 1 Type 874 - D20 Adjustable Stub
- 1 Type 874 - LA Adjustable Line
- 1 Type 874 - WN3 Short-Circuit Termination

(2) 2 turns #16 AWG wire, 3/8 inch OD, 1-1/4 inch long

(3) 9 turns #22 AWG wire, 3/16 inch OD, 1/2 inch long

TYPICAL PERFORMANCE

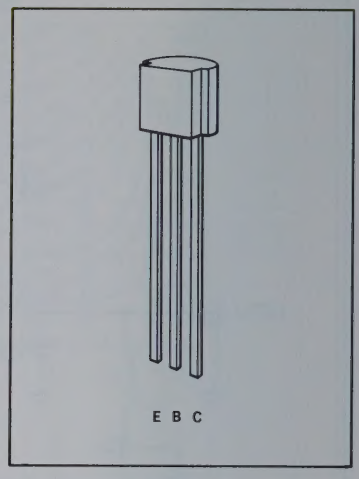


2N5771

PNP ULTRA-HIGH SPEED SWITCH

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **ULTRA-FAST SWITCHING TIME** . . . . . t_{off} = 20 ns MAX
- **LOW CAPACITY** . . . . . C_{obo} = 3.0 pF MAX AND C_{ibo} = 3.5 pF MAX
- **HIGH FREQUENCY** . . . . . f_t = 850 MHz MIN
- **LOW SATURATION VOLTAGE** . . . . . $V_{CE(sat)}$ = −0.18 V MAX AT I_C = 10 mA
- **HIGH BREAKDOWN VOLTAGE** . . . . . LV_{CEO} = −15 V MIN



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C Maximum
Operating Junction Temperature	150°C Maximum
Lead Temperature (Soldering, 60 sec Time Limit)	150°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.0 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	.625 Watt

Maximum Voltages and Current for Each Transistor

V_{CBO}	Collector to Base Voltage	−15 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−15 Volts
V_{EBO}	Emitter to Base Voltage	−4.5 Volts
I_C	Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
τ_s	Charge Storage Time (Note 6)		16	20	ns	I_C = 10 mA I_{B1} = I_{B2} = 10 mA
t_{on}	Turn On Time (Note 6)		11	15	ns	I_C = 10 mA I_{B1} = 10 mA
t_{off}	Turn Off Time (Note 6)		14	20	ns	I_C = 10 mA I_{B1} = I_{B2} = 1.0 mA
C_{obo}	Common Base, Open Circuit Output Capacitance		2.0	3.0	pF	I_E = 0 V_{CB} = −5.0 V
C_{ibo}	Common Base, Open Circuit Input Capacitance		2.4	3.5	pF	I_C = 0 V_{EB} = −0.5 V
h_{FE}	High Frequency Current Gain (f = 100 MHz)	8.5	13			I_C = 10 mA V_{CE} = −10 V
h_{FE}	DC Current Gain	35	60			I_C = 1.0 mA V_{CE} = −0.5 V
h_{FE}	DC Pulse Current Gain (Note 5)	50	67	120		I_C = 10 mA V_{CE} = −0.3 V
h_{FE}	DC Pulse Current Gain (Note 5)	40	60			I_C = 50 mA V_{CE} = −1.0 V
h_{FE}(−55°C)	DC Pulse Current Gain (Note 5)	20	40			I_C = 10 mA V_{CE} = −0.3 V
$V_{CE(sat)}$	Collector Saturation Voltage		−.07	−0.15	Volts	I_C = 1.0 mA I_B = 0.1 mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		−.08	−0.18	Volts	I_C = 10 mA I_B = 1.0 mA
$V_{CE(sat)}$	Pulsed Collector Saturation Voltage (Note 5)		−0.25	−0.6	Volts	I_C = 50 mA I_B = 5.0 mA
$V_{BE(sat)}$	Base Saturation Voltage		−0.73	−0.8	Volts	I_C = 1.0 mA I_B = 0.1 mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage	−0.8	−0.88	−0.95	Volts	I_C = 10 mA I_B = 1.0 mA
$V_{BE(sat)}$	Pulsed Base Saturation Voltage		−1.15	−1.5	Volts	I_C = 50 mA I_B = 5.0 mA
I_{CBO}	Collector to Base Cutoff Current			10	nA	V_{CB} = −8.0 V I_C = 0
I_{EBO}	Emitter to Base Cutoff Current			1.0	μA	V_{EB} = −4.5 V I_C = 0
I_{CES}	Collector Reverse Current		0.068	10	nA	V_{CE} = −8.0 V V_{BE} = 0
I_{CES}(125°C)	Collector Reverse Current		0.012	5.0	μA	V_{CE} = −8.0V V_{BE} = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.5			Volts	I_C = 0 I_E = 100μA
$V_{CEO(sust)}$	Collector to Emitter Sustaining Voltage (Note 4)	−15			Volts	I_C = 3.0 mA I_B = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	−15			Volts	I_C = 100μA V_{BE} = 0
BV_{CBO}	Collector to Base Breakdown Voltage	−15			Volts	I_C = 100μA I_B = 0

NOTES:

*Planar is a patented Fairchild process.

(1) These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to ambient thermal resistance of 125°C/watt (derating factor of 8.0 mW/°C). Junction to case thermal resistance of 200°C/watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest. For more information send for Fairchild Publication APP-4/2.

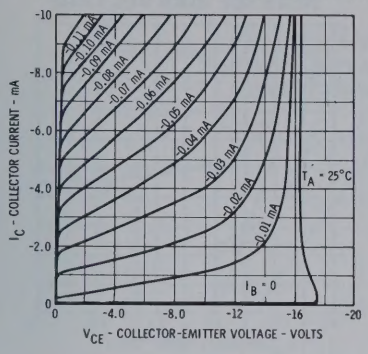
(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

(6) See switching circuit for exact values of I_C, I_{B1}, and I_{B2}.

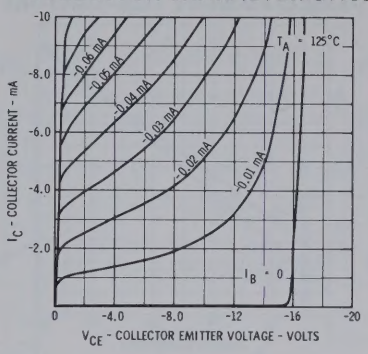
2N5771

TYPICAL ELECTRICAL CHARACTERISTICS

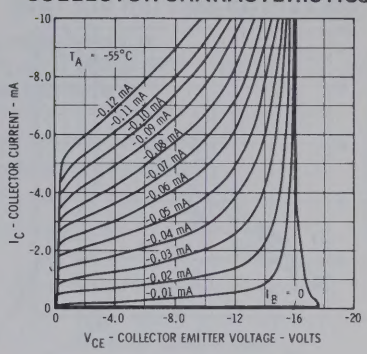
COLLECTOR CHARACTERISTICS*



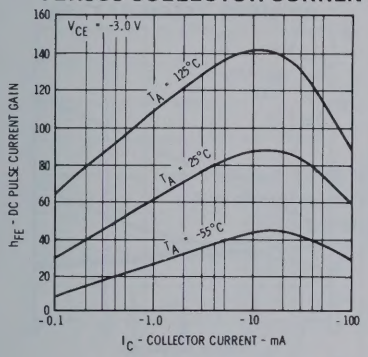
COLLECTOR CHARACTERISTICS*



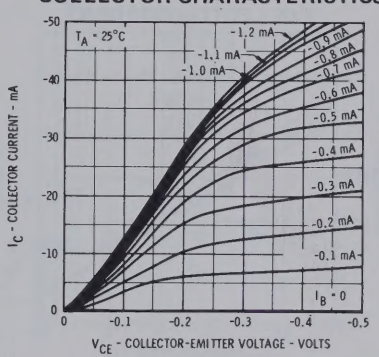
COLLECTOR CHARACTERISTICS*



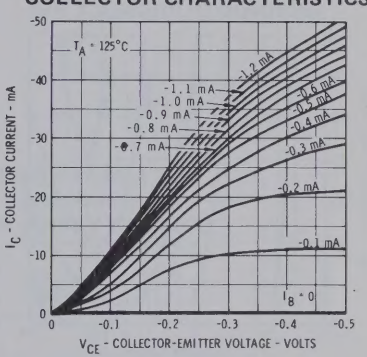
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



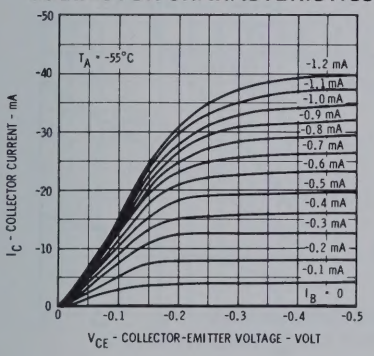
COLLECTOR CHARACTERISTICS*



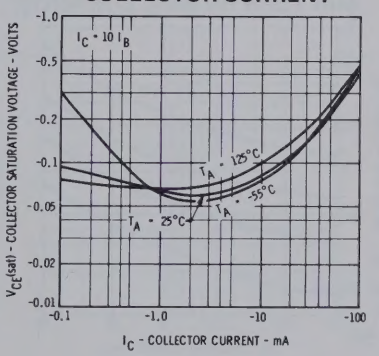
COLLECTOR CHARACTERISTICS*



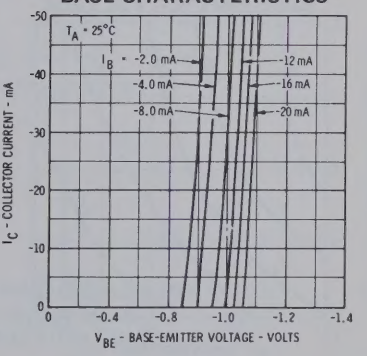
COLLECTOR CHARACTERISTICS*



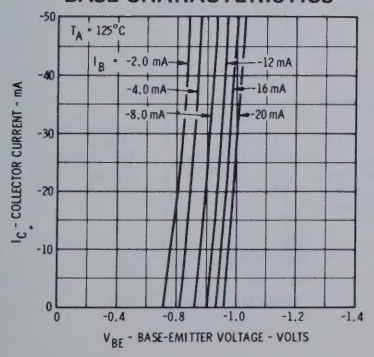
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



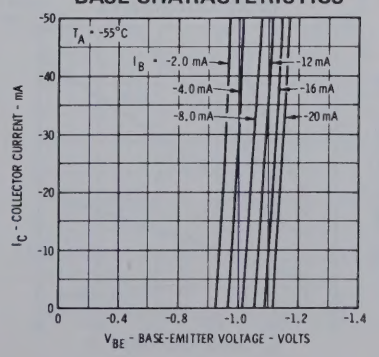
BASE CHARACTERISTICS*



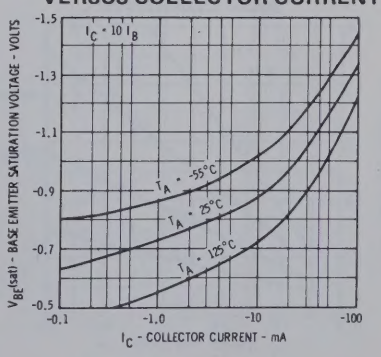
BASE CHARACTERISTICS*



BASE CHARACTERISTICS*

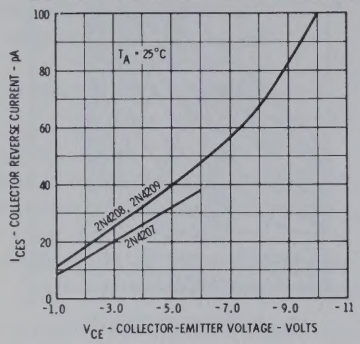


BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

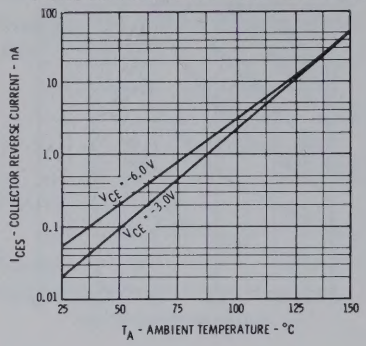


TYPICAL ELECTRICAL CHARACTERISTICS

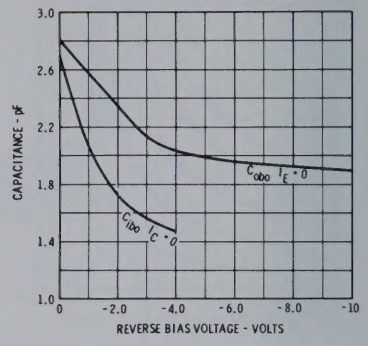
COLLECTOR REVERSE CURRENT VERSUS COLLECTOR-EMITTER VOLTAGE



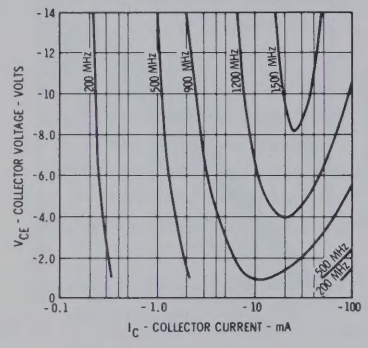
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



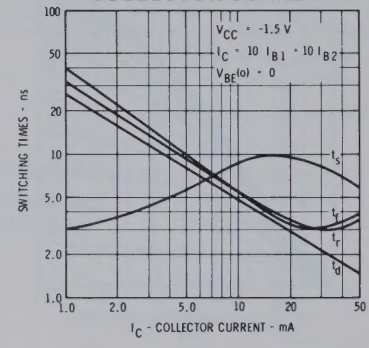
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



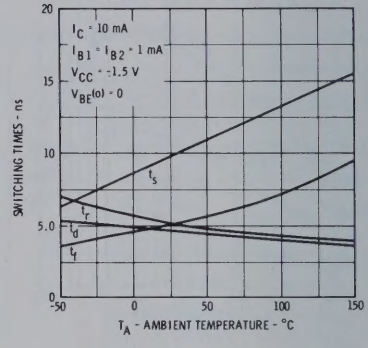
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



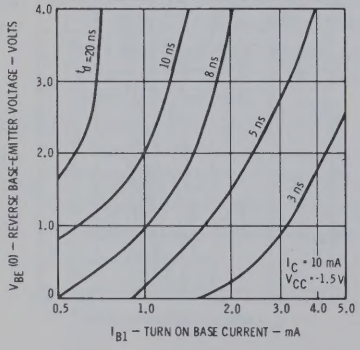
SWITCHING TIMES VERSUS COLLECTOR CURRENT



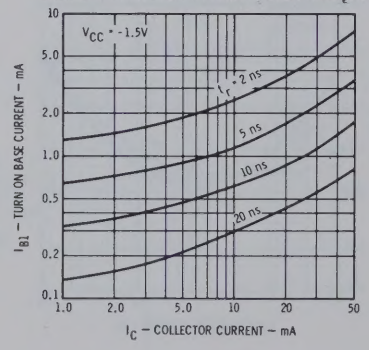
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



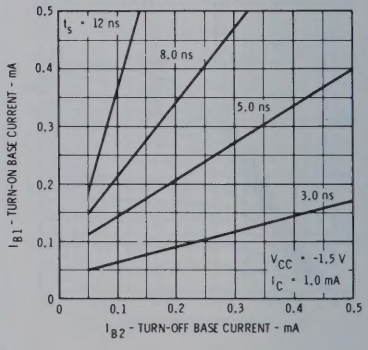
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



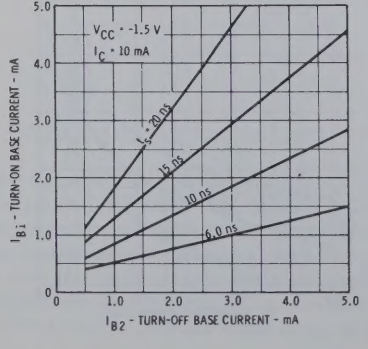
RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS



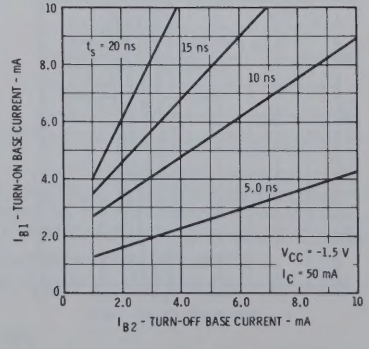
STORAGE TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



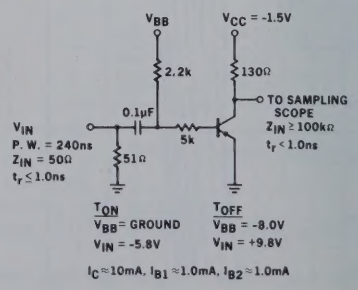
STORAGE TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



STORAGE TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS

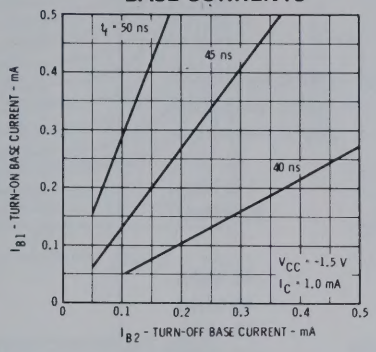


TURN ON AND TURN OFF TEST CIRCUIT

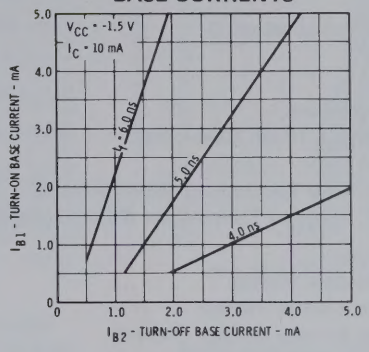


TYPICAL ELECTRICAL CHARACTERISTICS

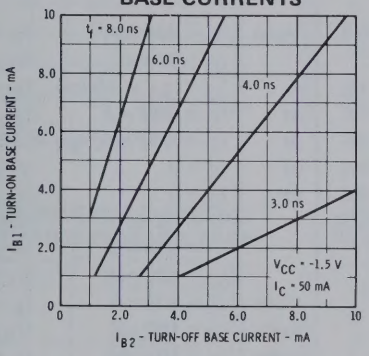
FALL TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



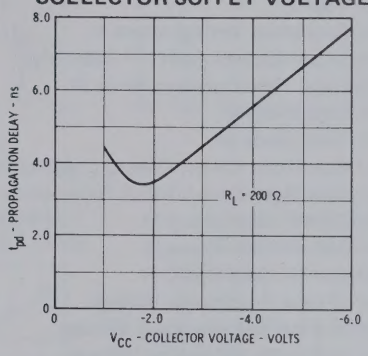
FALL TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



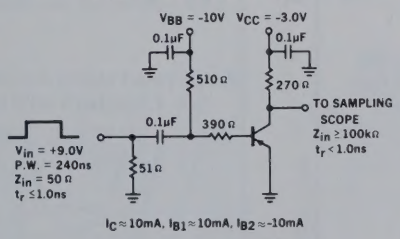
FALL TIME VERSUS TURN-ON AND TURN-OFF BASE CURRENTS



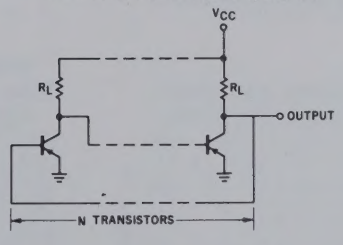
PROPAGATION DELAY TIME VERSUS COLLECTOR SUPPLY VOLTAGE



CHARGE STORAGE TIME TEST CIRCUIT



FIVE STAGE RING OSCILLATOR FOR MEASUREMENT OF PROPAGATION DELAY



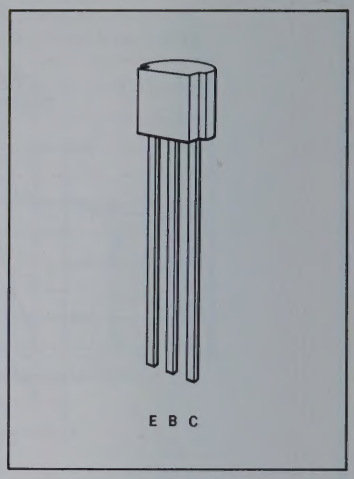
$$t_{pd} = \frac{1}{2Nf_{osc}}$$

2N5772

NPN HIGH SPEED SATURATED SWITCH

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH SPEED** . . . . . = 18 ns (MAX) AT 10 mA
  . . . . . t_{on} = 18 ns (MAX) AT 300 mA
  . . . . . t_{off} = 28 ns (MAX) AT 300 mA
- **MEDIUM VOLTAGE** . . . . $V_{CEO(sust)}$ = 15 V (MIN)
- **HIGH FREQUENCY** . . . . f_T = 350 MHz AT 30 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C Maximum
Operating Junction Temperature	150°C Maximum
Lead Temperature (Soldering, 10 sec Time Limit)	260°C Maximum

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.0 Watt
at 25°C Ambient Temperature (Notes 2 and 3)	.625 Watt

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	40 Volts
V_{CES}	Collector to Emitter Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	15 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.16	0.2	Volts	I_C = 30 mA	I_B = 3.0 mA
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.18	0.28	Volts	I_C = 100 mA	I_B = 10 mA
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5) (T_A = +65°C)		0.18	0.3	Volts	I_C = 30 mA	I_B = 3.0 mA
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.39	0.5	Volts	I_C = 300 mA	I_B = 30 mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.5	5.5			I_C = 30 mA	V_{CE} = 10 V
τ_s	Charge Storage Time Constant (Note 6)		8.0	18	ns	$I_C = I_{B1} \approx$ 10 mA	$I_{B2} \approx$ -10 mA
t_{on}	Turn On Time (Note 6)		9.0	18	ns	$I_C \approx$ 300 mA	$I_{B1} \approx$ 30 mA
t_{off}	Turn Off Time (Note 6)		15	28	ns	$I_C \approx$ 300 mA, $I_{B1} \approx$ 30 mA, $I_{B2} \approx$ -30 mA	
C_{obo}	Common Base Open Circuit Output Capacitance		3.3	5.0	pF	I_E = 0	V_{CB} = 5.0 V
C_{ibo}	Common Base Open Circuit Input Capacitance		6.6	8.0	pF	I_C = 0	V_{EB} = 0.5 V
h_{FE}	DC Pulse Current Gain (Note 5)	30	60	120		I_C = 30 mA	V_{CE} = 0.4 V
h_{FE}	DC Pulse Current Gain (Note 5)	25	55			I_C = 100 mA	V_{CE} = 0.5 V
h_{FE}	DC Pulse Current Gain (Note 5)	15				I_C = 300 mA	V_{CE} = 1.0 V
BV_{CBO}	Collector to Base Breakdown Voltage	40			Volts	I_C = 100 μA	I_E = 0
BV_{CES}	Collector to Emitter Breakdown Voltage	40			Volts	I_C = 100 μA	V_{EB} = 0
$V_{CEO(sust)}$	Collector to Emitter Sustaining Voltage (Notes 4 and 5)	15			Volts	I_C = 10 mA	I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			Volts	I_E = 100 μA	I_C = 0
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)	0.75	0.82	0.95	Volts	I_C = 30 mA	I_B = 3.0 mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.97	1.2	Volts	I_C = 100 mA	I_B = 10 mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		1.3	1.7	Volts	I_C = 300 mA	I_B = 30 mA
I_{CES}	Collector Reverse Current		0.04	0.5	μA	V_{CE} = 20 V	V_{EB} = 0
I_{CES}(65°C)	Collector Reverse Current		0.5	3.0	μA	V_{CE} = 20 V	V_{EB} = 0
I_{CBO}	Collector to Base Cutoff Current			0.5	μA	V_{CB} = 20 V	I_E = 0
I_{EBO}	Emitter to Base Cutoff Current			1.0	μA	V_{EB} = 5.0 V	I_C = 0

*Planar is a patented Fairchild process.

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C). Junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

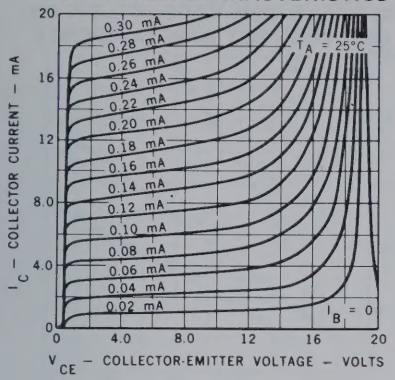
(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse Conditions: length = 300 μs; duty cycle = 1%.

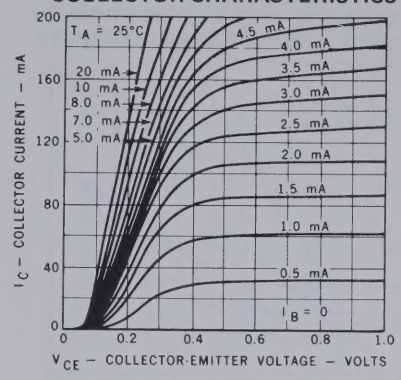
(6) See switching circuits for exact values of I_C, I_{B1}, and I_{B2}.

TYPICAL ELECTRICAL CHARACTERISTICS

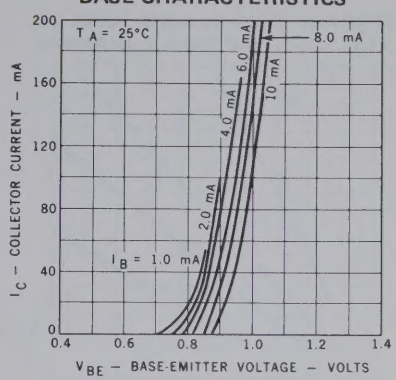
COLLECTOR CHARACTERISTICS*



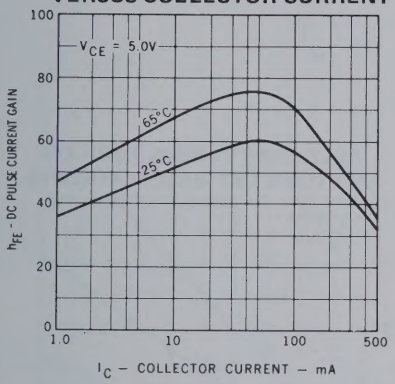
COLLECTOR CHARACTERISTICS*



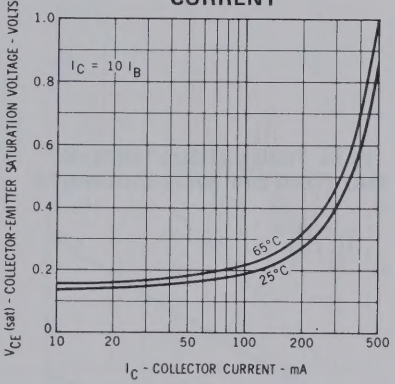
BASE CHARACTERISTICS*



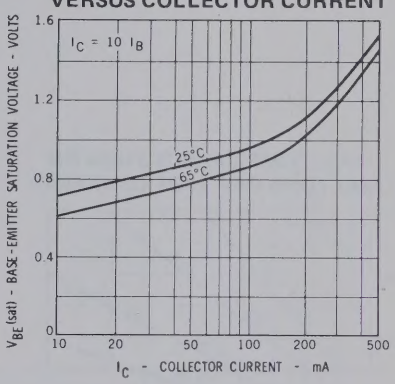
DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



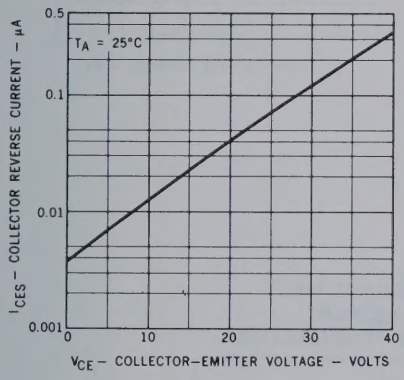
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



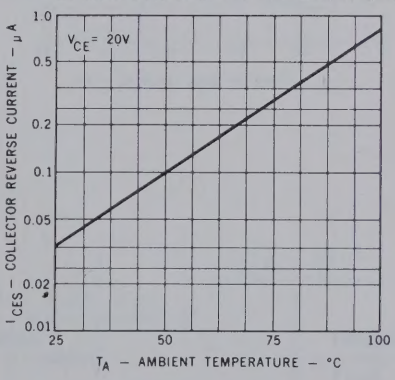
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



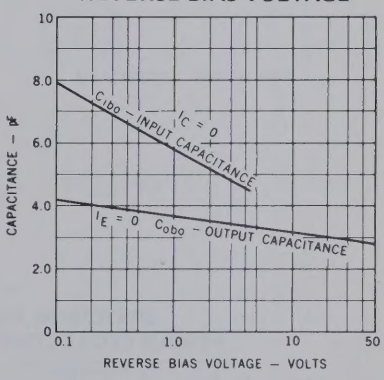
COLLECTOR REVERSE CURRENT VERSUS REVERSE BIAS VOLTAGE



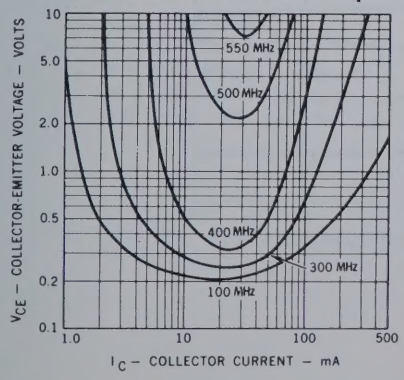
COLLECTOR REVERSE CURRENT VERSUS AMBIENT TEMPERATURE



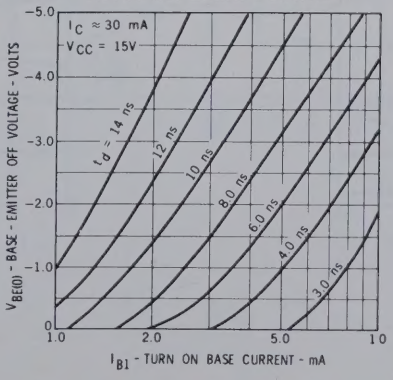
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



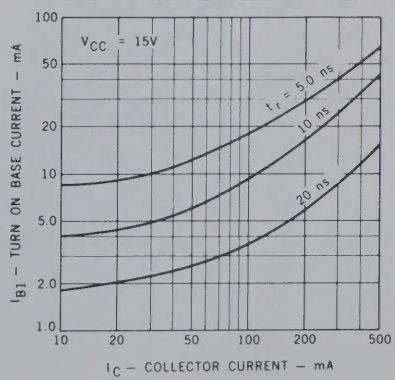
CONTOURS OF CONSTANT GAIN BANDWIDTH PRODUCT (f_T)



DELAY TIME VERSUS BASE EMITTER OFF VOLTAGE AND TURN ON BASE CURRENT

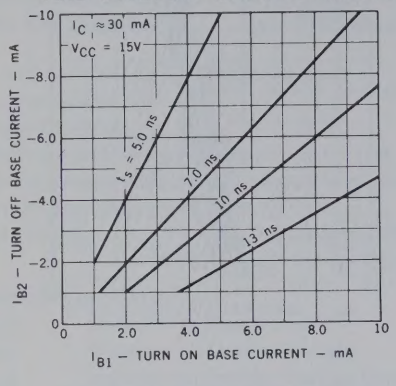


RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS

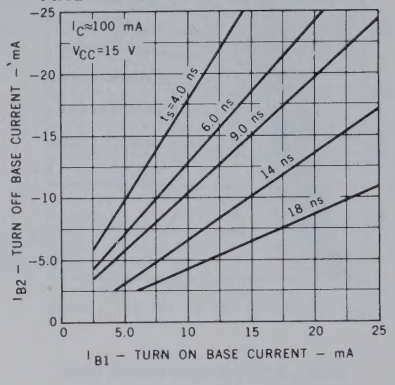


TYPICAL ELECTRICAL CHARACTERISTICS

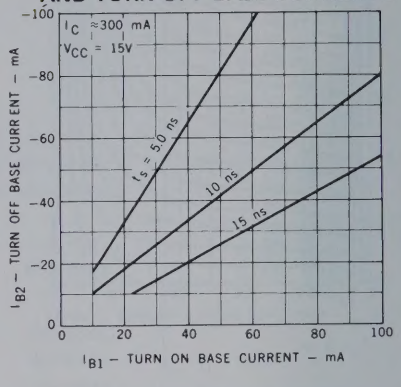
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



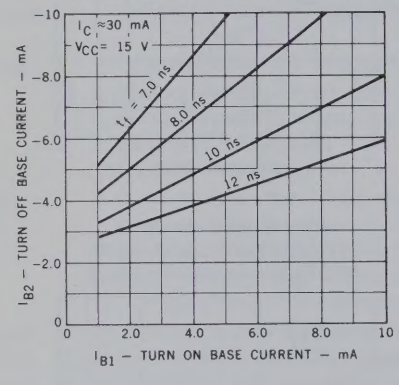
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



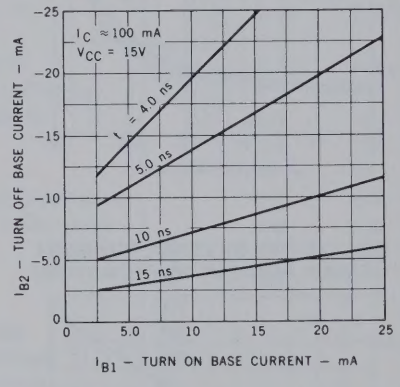
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



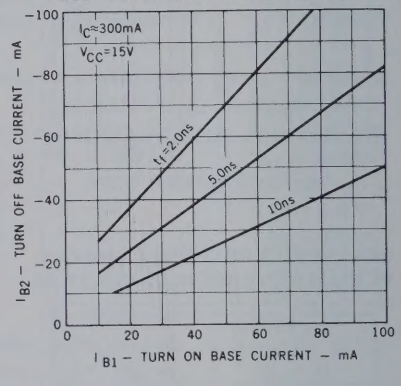
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



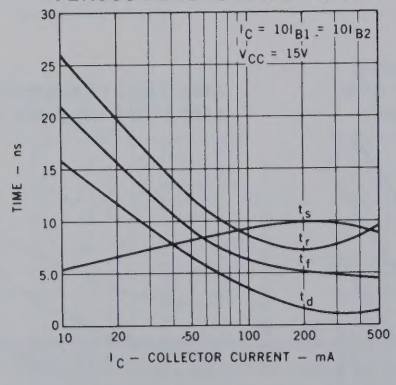
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



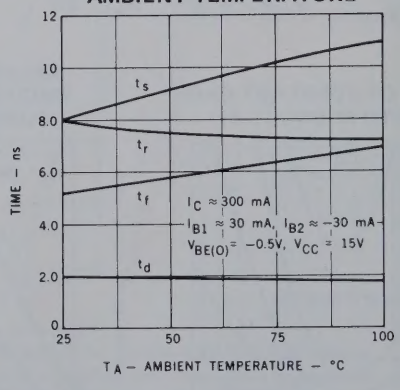
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



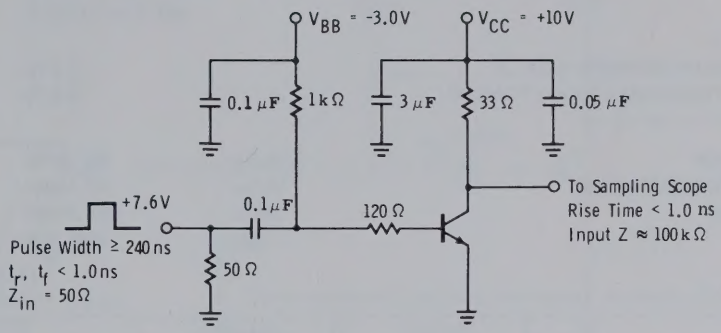
SWITCHING TIMES VERSUS COLLECTOR CURRENT



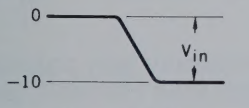
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



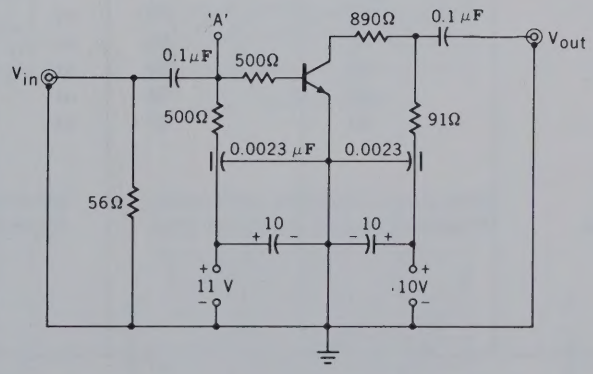
t_{on} AND t_{off} TEST CIRCUIT

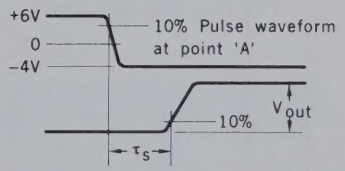


CHARGE STORAGE TIME MEASUREMENT



Pulse Generator
V_{in} Rise Time < 1 ns
Source Impedance = 50Ω
PW ≥ 300 ns
Duty Cycle < 2%





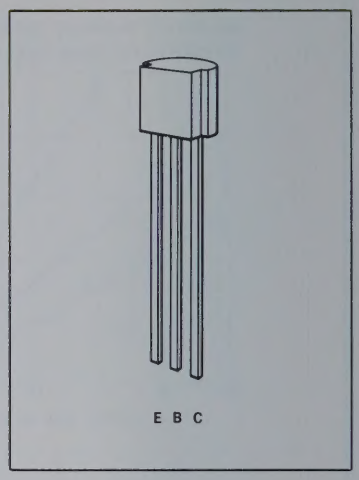
To Sampling Oscilloscope
Z_{IN} ≈ 100 kΩ
Rise Time ≤ 1 ns

2N5845 • 2N5845A

NPN HIGH SPEED, HIGH CURRENT SWITCHES

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH SPEED** . . . . . t_{on} = 30 ns (MAX) AT 500 mA
  . . . . . t_{off} = 50 ns (MAX) AT 500 mA
- **HIGH VOLTAGE** . . . . . V_{CEO} = 40 V (MIN)
- **HIGH GAIN** . . . . . h_{FE} = 35-150 AT 500 mA, 1.0 V
  . . . . . h_{FE} = 50-200 AT 100 mA, 1.0 V
- **LOW SATURATION VOLTAGE** . . V_{CE}(sat) = 0.5 V (MAX) AT 500 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +135°C
Operating Junction Temperature	−55°C to +135°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature (Notes 2 and 3)	1.2 W
at 25°C Ambient Temperature (Notes 2 and 3)	0.5 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	Volts	50 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	Volts	40 Volts
V_{EBO}	Emitter to Base Voltage	Volts	6.0 Volts
I_C	Collector Current	mA	600 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5845 MIN.	2N5845 MAX.	2N5485A MIN.	2N5485A MAX.	UNITS	TEST CONDITIONS	
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	40		40		Volts	I_C = 10 mA,	I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	50		50		Volts	I_C = 100 μA,	I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	6.0		6.0		Volts	I_E = 10 μA,	I_C = 0
I_{CBO}	Collector Cutoff Current		500		500	nA	V_{CB} = 40 V,	I_E = 0
I_{EBO}	Emitter Cutoff Current		50		50	nA	V_{EB} = 4.0 V,	I_C = 0
h_{FE}	DC Current Gain	50		50			I_C = 10 mA,	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	50	200	50	200		I_C = 100 mA,	V_{CE} = 1.0 V
h_{FE}	DC Pulse Current Gain (Note 5)	25	150	35	150		I_C = 500 mA,	V_{CE} = 1.0 V
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.25		0.25	Volt	I_C = 100 mA,	I_B = 10 mA
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		0.6		0.5	Volt	I_C = 500 mA,	I_B = 50 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		0.85		0.85	Volt	I_C = 100 mA,	I_B = 10 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)	0.8	1.1	0.8	1.1	Volts	I_C = 500 mA,	I_B = 50 mA
f_T	Current Gain Bandwidth Product (f = 100 MHz)	2.0		2.5		MHz	I_C = 50 mA,	V_{CE} = 10 V
C_{cb}	Collector to Base Capacitance (f = 100 kHz)		9.0		9.0	pF	V_{CB} = 10 V,	I_E = 0
C_{ib}	Emitter to Base Capacitance (f = 100 kHz)		70		70	pF	V_{EB} = 0.5 V,	I_C = 0
t_{on}	Turn On Time (See Figure 1)		40		30	ns	I_C = 500 mA,	I_{B1} ≈ 50 mA
t_d	Delay Time (See Figure 1)		17		15	ns	I_C = 500 mA,	I_{B1} ≈ 50 mA
t_r	Rise Time (See Figure 1)		28		25	ns	I_C = 500 mA,	I_{B1} ≈ 50 mA
t_{off}	Turn Off Time (See Figure 1)		60		50	ns	I_C = 500 mA,	I_{B1} ≈ 50 mA
t_s	Storage Time (See Figure 1)		40		38	ns	I_C = 500 mA,	$I_{B1} \approx I_{B2} \approx 50$ mA
t_f	Fall Time (See Figure 1)		30		27	ns	I_C = 500 mA,	$I_{B1} \approx I_{B2} \approx 50$ mA

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

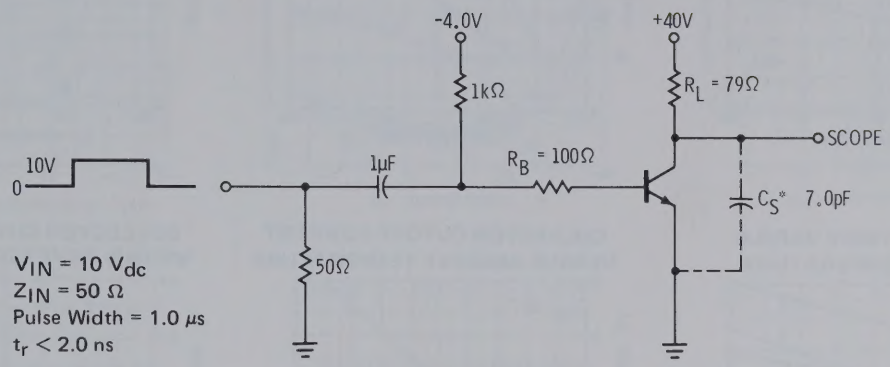
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 135°C and junction to case thermal resistance of 92°C/Watt (derating factor of 10.9 mW/°C); junction to ambient thermal resistance of 220°C/Watt (derating factor of 4.54 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse conditions: length = 300 μs; duty cycle = 2%.

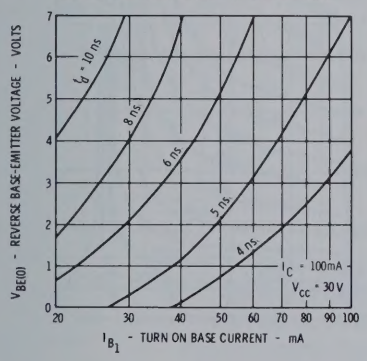
FIGURE 1 – SWITCHING TIME TEST CIRCUIT



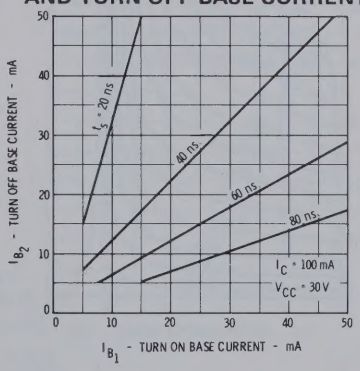
*Total shunt capacitance of test jig connectors & oscilloscope.

TYPICAL ELECTRICAL CHARACTERISTICS

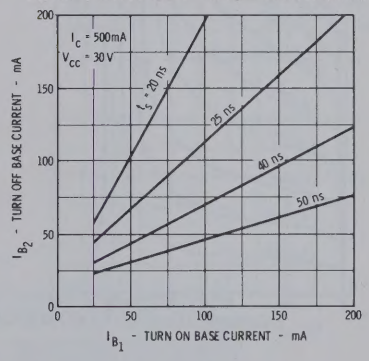
DELAY TIME VERSUS TURN ON BASE CURRENT AND REVERSE BASE EMITTER VOLTAGE



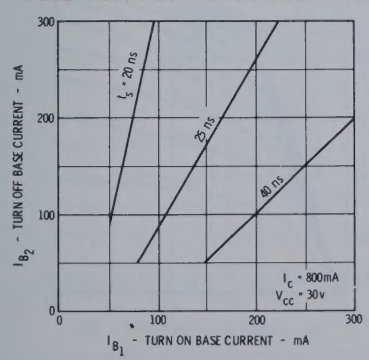
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



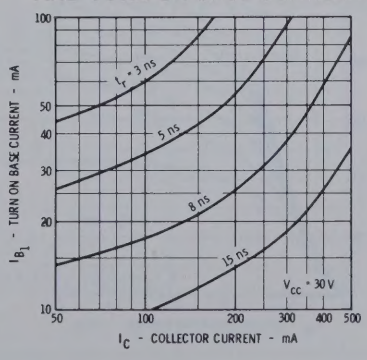
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



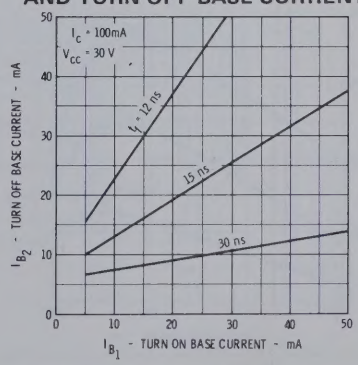
STORAGE TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



RISE TIME VERSUS COLLECTOR AND TURN ON BASE CURRENTS

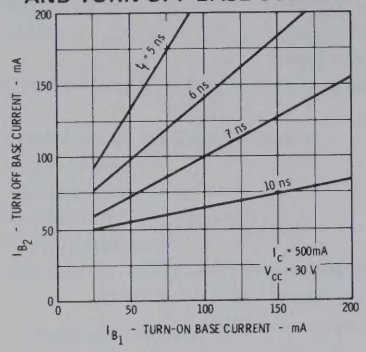


FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS

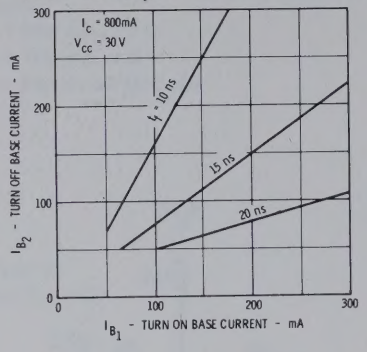


TYPICAL ELECTRICAL CHARACTERISTICS

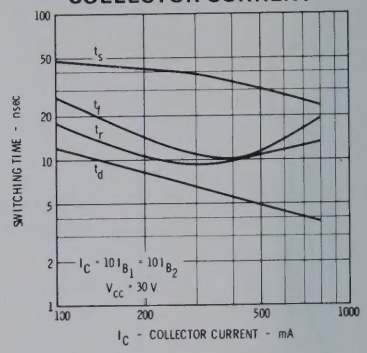
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



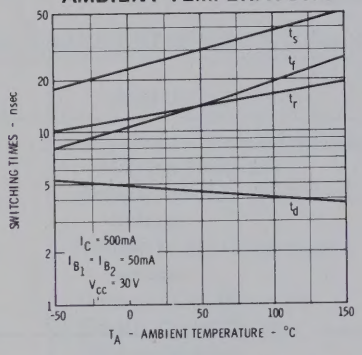
FALL TIME VERSUS TURN ON AND TURN OFF BASE CURRENTS



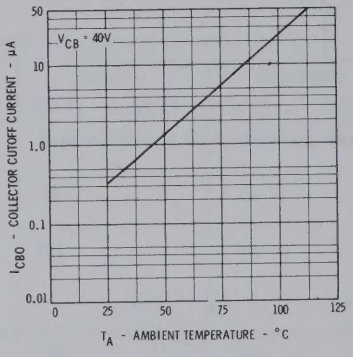
SWITCHING TIMES VERSUS COLLECTOR CURRENT



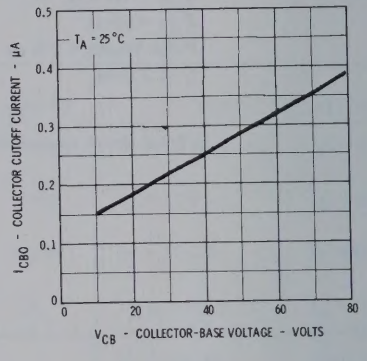
SWITCHING TIMES VERSUS AMBIENT TEMPERATURE



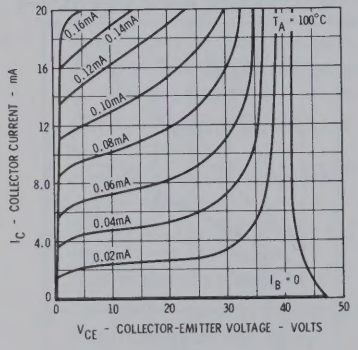
COLLECTOR CUTOFF CURRENT VERSUS AMBIENT TEMPERATURE



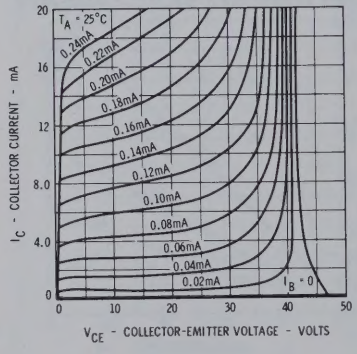
COLLECTOR CUTOFF CURRENT VERSUS REVERSE BIAS VOLTAGE



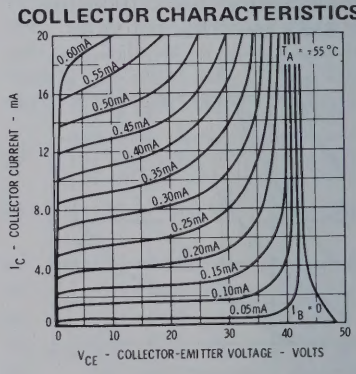
COLLECTOR CHARACTERISTICS*



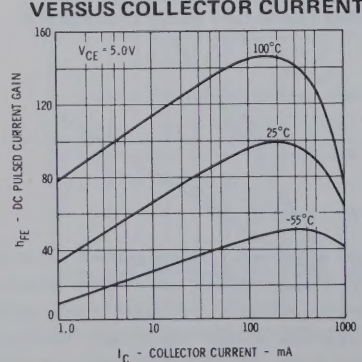
COLLECTOR CHARACTERISTICS*



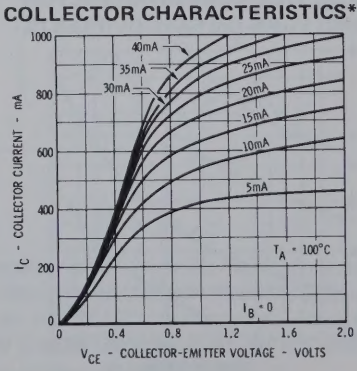
COLLECTOR CHARACTERISTICS*



DC PULSED CURRENT GAIN VERSUS COLLECTOR CURRENT



COLLECTOR CHARACTERISTICS*



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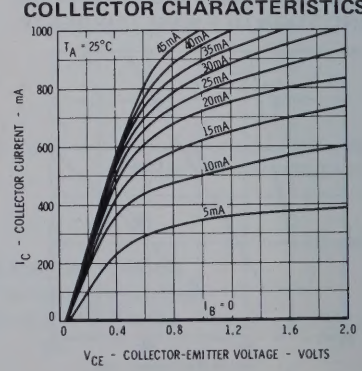
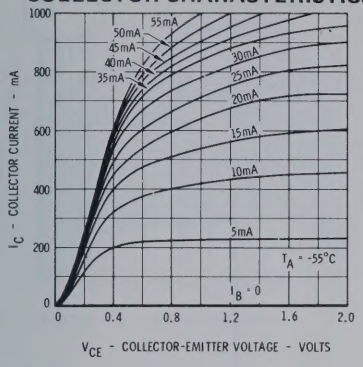
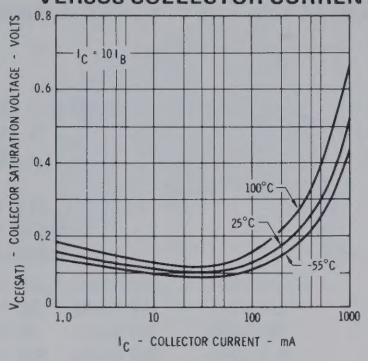


TYPICAL ELECTRICAL CHARACTERISTICS

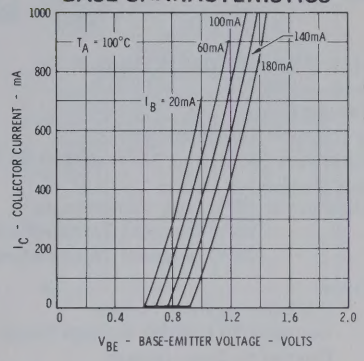
COLLECTOR CHARACTERISTICS*



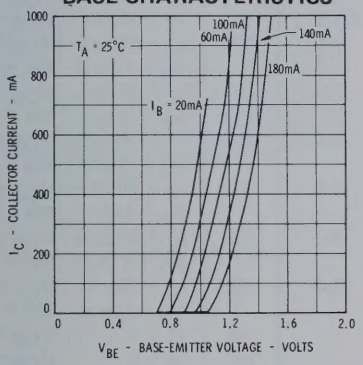
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



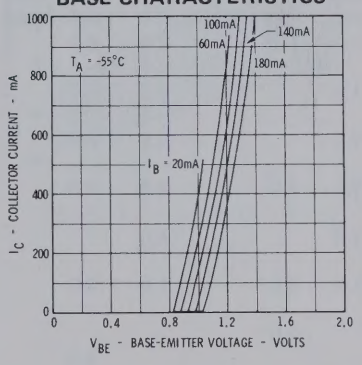
BASE CHARACTERISTICS*



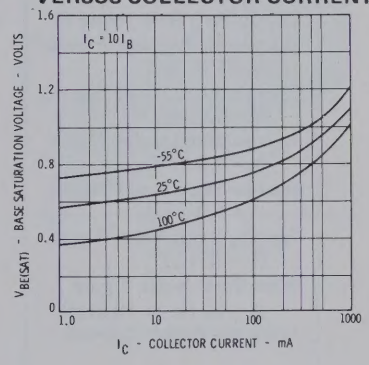
BASE CHARACTERISTICS*



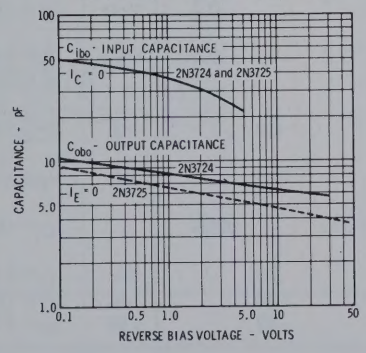
BASE CHARACTERISTICS*



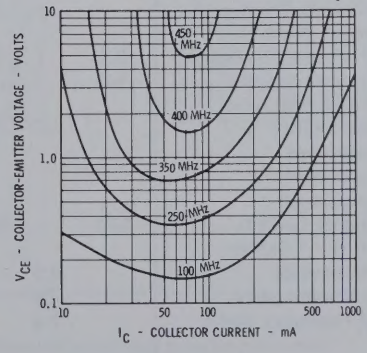
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



INPUT AND OUTPUT CAPACITANCE VERSUS REVERSE BIAS VOLTAGE



CONTOURS OF CONSTANT BANDWIDTH PRODUCT (f_T)



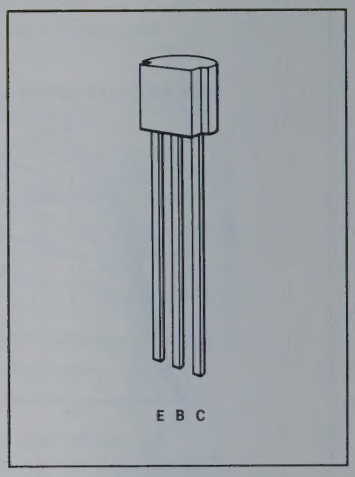
*Single family characteristics on Transistor Curve Tracer.

2N5961 • 2N5962 • 2N5963

NPN LOW LEVEL, LOW NOISE AMPLIFIERS

DIFFUSED SILICON PLANAR EPITAXIAL TRANSISTORS

- LOW 1/f NOISE . . . . . NF = 8.0dB (MAX) AT 10Hz, 1.0kΩ (2N5963)
- HIGH GAIN . . . . . h_{FE} = 900 (MIN) AT 10μA (2N5963)
  h_{FE} = 1200 (MIN) AT 10mA (2N5963)
- LOW SATURATION VOLTAGE . . $V_{CE(sat)}$ = 0.2 V (MAX) AT 10mA/0.5mA
- LOW LEAKAGE . . . . . I_{CBO} = 2.0nA (MAX) AT V_{CB} = 45 V (2N5961)
  I_{CBO} = 50nA (MAX) AT V_{CB} = 45 V, T_A = 65°C (2N5961)



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

†Storage Temperatures	−55°C to + 150°C
Operating Junction Temperatures	+ 150°C
†Lead Temperature (Soldering, 10 seconds time limit)	+ 260°C

Maximum Power Dissipation (Notes 2 and 3)

†Total Dissipation at 25°C Case Temperature	1.0 Watt
25°C Ambient Temperature	0.625 Watt
70°C Ambient Temperature	0.400 Watt

Maximum Voltages

		2N5961	2N5962	2N5963
†V_{CBO}	Collector to Base Voltage	60 Volts	45 Volts	30 Volts
†V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts	45 Volts	30 Volts
†$_{EBO}$	Emitter to Base Voltage	8.0 Volts	8.0 Volts	8.0 Volts
†I_C	Continuous Collector Current	50 mA	50 mA	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	2N5961 MIN.	2N5961 TYP.	2N5961 MAX.	2N5962 MIN.	2N5962 TYP.	2N5962 MAX.	2N5963 MIN.	2N5963 TYP.	2N5963 MAX.	UNITS	TEST CONDITIONS
†h_{FE}	**DC Current Gain**	100	200		450	735		**900**	**1100**			**I_C = 10μA V_{CE} = 5.0V**
†h_{FE}	DC Current Gain	120	250		500	840		1000	1580			I_C = 100μA V_{CE} = 5.0V
†h_{FE}	DC Current Gain	135	290		550	960		1200	1735			I_C = 1.0mA V_{CE} = 5.0V
†h_{FE}	**DC Current Gain (Note 5)**	150	310	700	600	950	1400	**1200**	**1540**	**2200**		**I_C = 10mA V_{CE} = 5.0V**
†NF	Narrow-Band Noise Figure (f = 1.0 kHz)		2.5	6.0		3.5	6.0		4.0	6.0	dB	I_C = 100μA V_{CE} = 5.0V R_S = 1.0kΩ BW = 400Hz
†NF	Narrow-Band Noise Figure (f = 1.0 kHz)		1.5			1.5	4.0		1.5	3.0	dB	I_C = 100μA V_{CE} = 5.0V R_S = 10kΩ BW = 400Hz
†NF	Narrow-Band Noise Figure (f = 1.0 kHz)		4.0			2.5	8.0		1.5	6.0	dB	I_C = 100μA V_{CE} = 5.0V R_S = 100kΩ BW = 400Hz
†NF	**Narrow-Band Noise Figure (f = 1.0 kHz)**		**1.5**	**3.0**		**1.5**	**3.0**		**1.5**	**3.0**	**dB**	**I_C = 10μA V_{CE} = 5.0V R_S = 10kΩ BW = 400Hz**
†NF	Narrow-Band Noise Figure (f = 10 Hz)		2.5			4.0			5.0	8.0	dB	I_C = 100μA V_{CE} = 5.0V R_S = 1.0kΩ BW = 10Hz
†NF	Wide-Band Noise Figure (f = 10 Hz to 10 kHz)		1.0	3.0		1.0	3.0		1.0	3.0	dB	I_C = 10μA V_{CE} = 5.0V R_S = 10kΩ BW = 15.7kHz
†I_{CBO}	Collector Cutoff Current			2.0							nA	I_E = 0 V_{CB} = 45V
							2.0				nA	I_E = 0 V_{CB} = 30V
										2.0	nA	I_E = 0 V_{CB} = 20V
†I_{CBO}(65°C)	**Collector Cutoff Current**			**50**							**nA**	**I_E = 0 V_{CB} = 45V**
							50				nA	I_E = 0 V_{CB} = 30V
										50	nA	I_E = 0 V_{CB} = 20V
†I_{EBO}	Emitter Cutoff Current			1.0			1.0			1.0	nA	I_C = 0 V_{EB} = 5.0V
†BV_{CEO}	Collector to Emitter Breakdown Voltage	60			45			30			Volts	I_C = 5.0mA I_B = 0
†BV_{CBO}	Collector to Base Breakdown Voltage	60			45			30			Volts	I_C = 10μA I_E = 0
†BV_{EBO}	Emitter to Base	8.0			8.0			8.0			Volts	I_E = 10μA I_C = 0
†$V_{CE(sat)}$	**Collector Saturation Voltage (Note 5)**			**0.2**			**0.2**			**0.2**	**Volt**	**I_C = 10mA I_B = 0.5mA**
†$V_{BE(on)}$	Base to Emitter Voltage	0.5		0.7	0.5		0.7	0.5		0.7	Volt	I_C = 1.0mA V_{CE} = 5.0V
†h_{fe}	High Frequency Gain (f = 100 MHz)	1.0			1.0		1.5					I_C = 10mA V_{CE} = 5.0V
†C_{cb}	Collector to Base Capacitance			4.0		4.0			4.0		pF	V_{CB} = 5.0V I_E = 0
†C_{eb}	Emitter to Base Capacitance			6.0		6.0			6.0		pF	V_{EB} = 0.5V I_C = 0
†h_{fe}	Small Signal Current Gain (f = 1.0kHz)	150		1000	600		2000	1200		3000		I_C = 10mA V_{CE} = 5.0V
h_{ie}	Input Resistance		8.5			28			39		kΩ	I_C = 1.0mA V_{CE} = 10V
h_{oe}	Output Conductance		24			74			120		kΩ	I_C = 1.0mA V_{CE} = 10V
h_{re}	Voltage Feedback Ratio		7.0			23			33		x10	I_C = 1.0mA V_{CE} = 10V

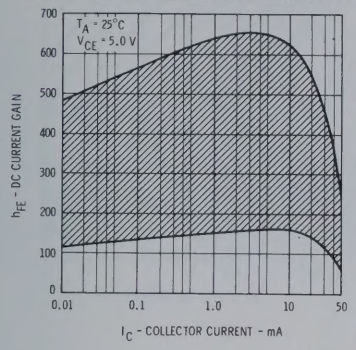
†JEDEC Registered Values

*Planar is a patented Fairchild process

TYPICAL ELECTRICAL CHARACTERISTICS (See Note 6)

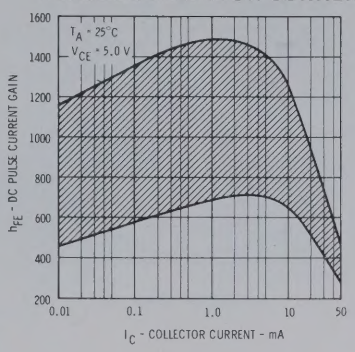
2N5961

DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT



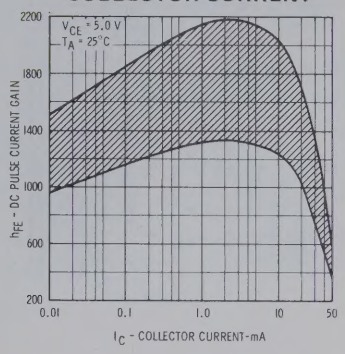
2N5962

DC PULSE CURRENT GAIN VERSUS COLLECTOR CURRENT

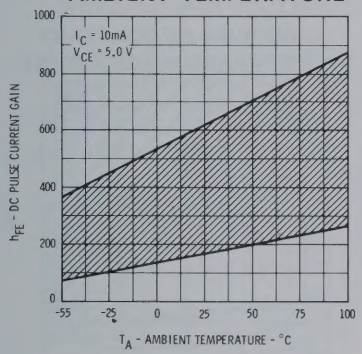


2N5963

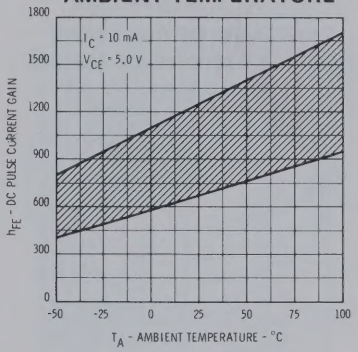
DC CURRENT GAIN VERSUS COLLECTOR CURRENT



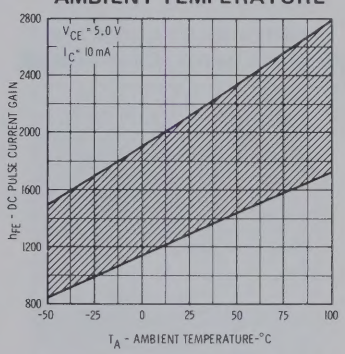
DC PULSE CURRENT GAIN VERSUS AMBIENT TEMPERATURE



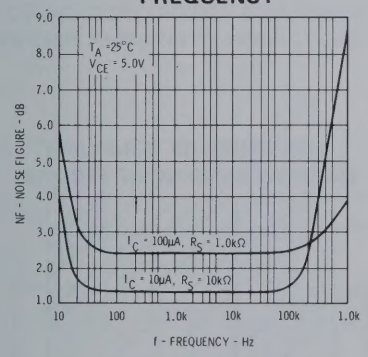
DC PULSE CURRENT GAIN VERSUS AMBIENT TEMPERATURE



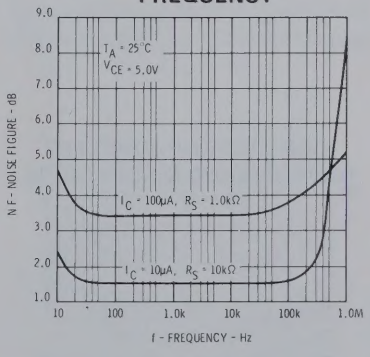
DC PULSE CURRENT GAIN VERSUS AMBIENT TEMPERATURE



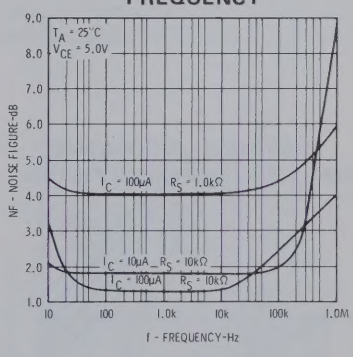
NOISE FIGURE VERSUS FREQUENCY



NOISE FIGURE VERSUS FREQUENCY



NOISE FIGURE VERSUS FREQUENCY



NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0mW/°C).

(4) This rating refers to a high current point where collector to emitter voltage is lowest.

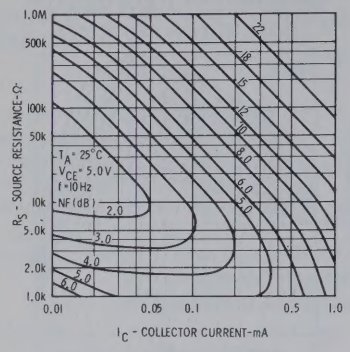
(5) Pulse Conditions: length = 300μs; duty cycle 1%.

(6) In recognition of the needs of computer aided design, correlation and distribution information is shown for key parameters. These curves are not guaranteed but represent with a high degree of confidence the distributions and correlations to be expected.

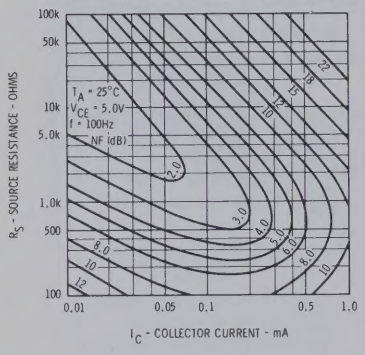
TYPICAL ELECTRICAL CHARACTERISTICS

2N5961

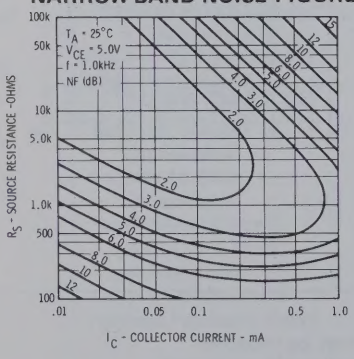
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE

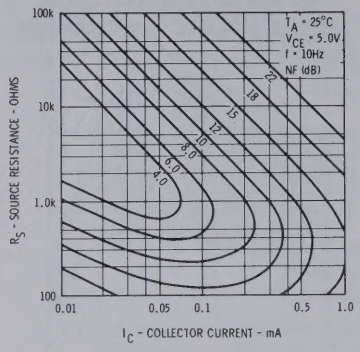


CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE

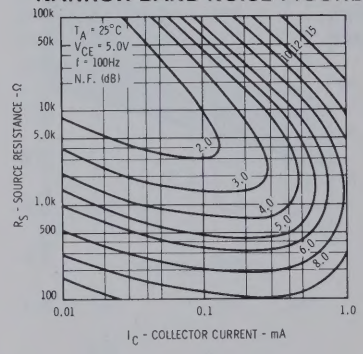


2N5962

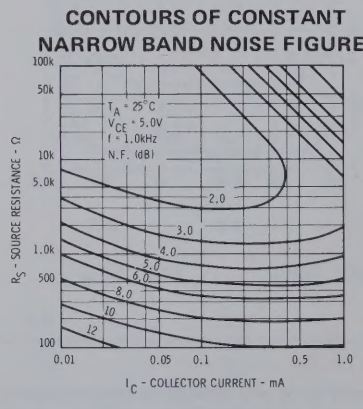
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



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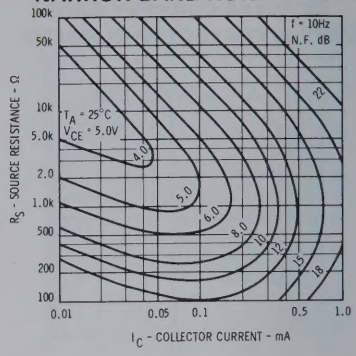
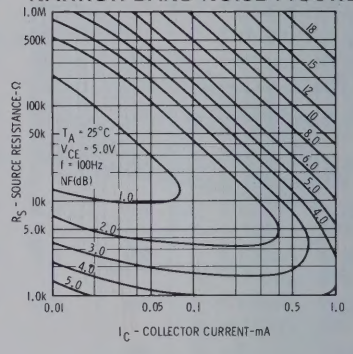
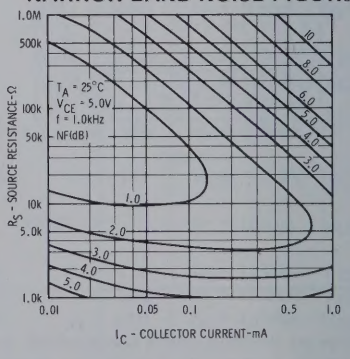
CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE



CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE

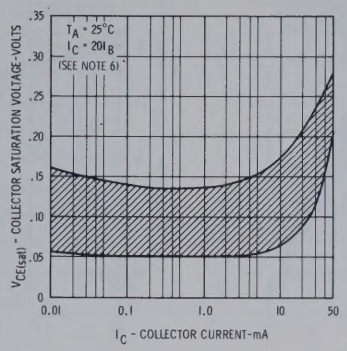


CONTOURS OF CONSTANT NARROW BAND NOISE FIGURE

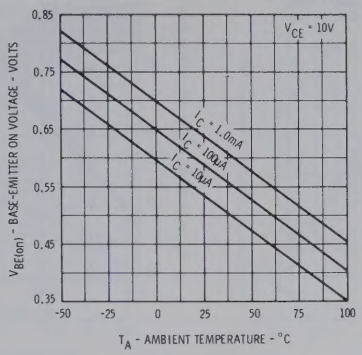


TYPICAL ELECTRICAL CHARACTERISTICS

COLLECTION SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

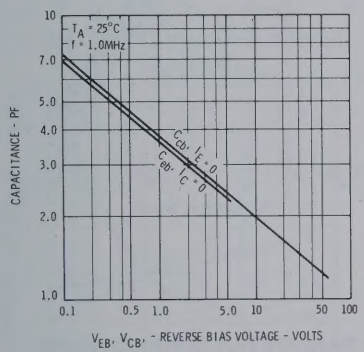


BASE-EMITTER ON VOLTAGE VERSUS AMBIENT TEMPERATURE



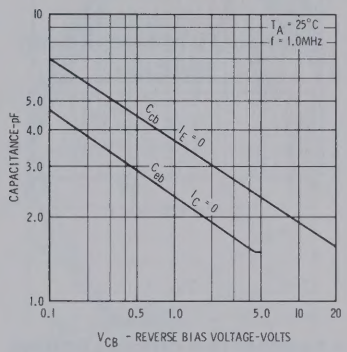
2N5961

INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



2N5962

INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



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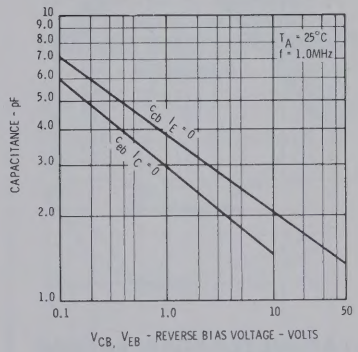
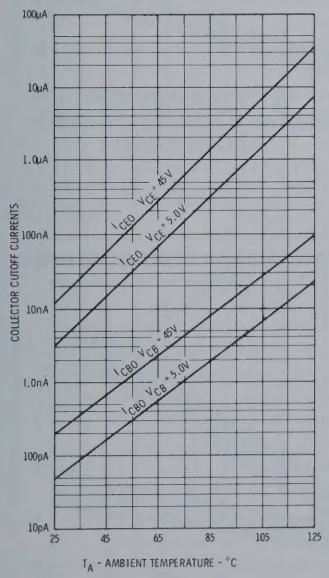
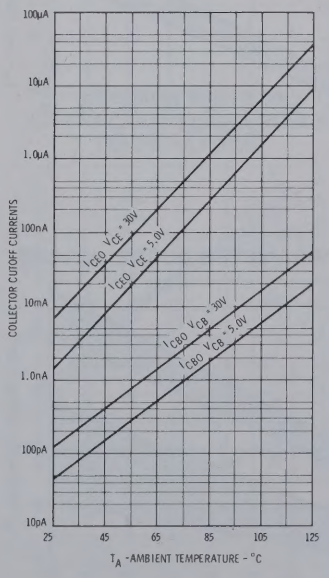
INPUT AND OUTPUT CAPACITANCES VERSUS REVERSE BIAS VOLTAGE



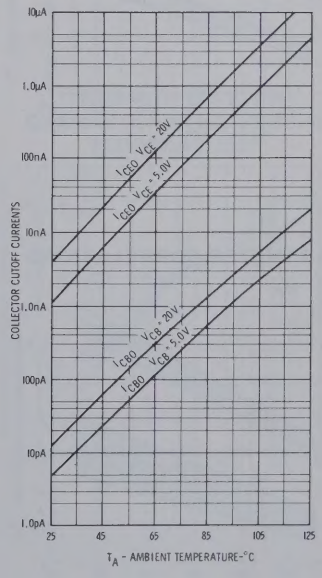
COLLECTOR CUTOFF CURRENTS VERSUS AMBIENT TEMPERATURE



COLLECTOR CUTOFF CURRENTS VERSUS AMBIENT TEMPERATURE

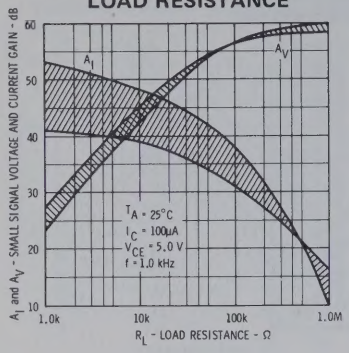


COLLECTOR CUTOFF CURRENTS VERSUS AMBIENT TEMPERATURE



2N5961

SMALL SIGNAL VOLTAGE & CURRENT GAIN VERSUS LOAD RESISTANCE



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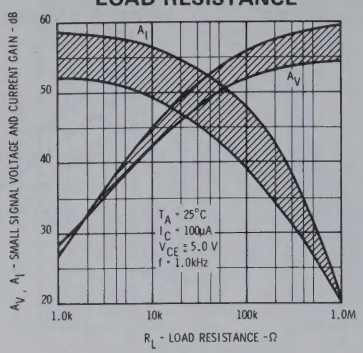
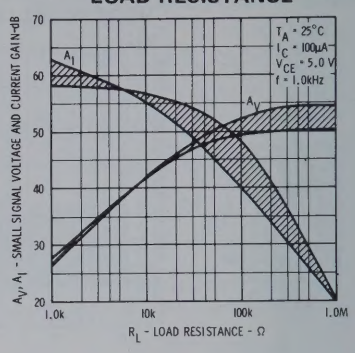
SMALL SIGNAL VOLTAGE & CURRENT GAIN VERSUS LOAD RESISTANCE

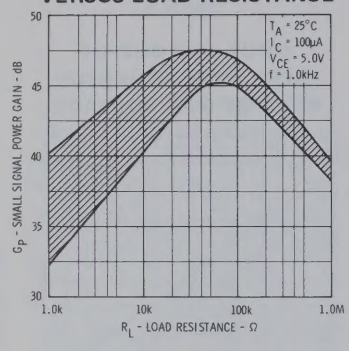


2N5963

SMALL SIGNAL VOLTAGE & CURRENT GAIN VERSUS LOAD RESISTANCE



SMALL SIGNAL POWER GAIN VERSUS LOAD RESISTANCE



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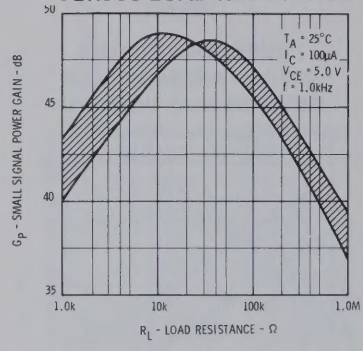

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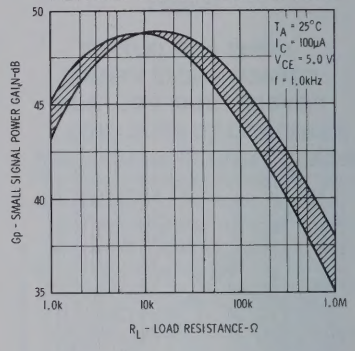
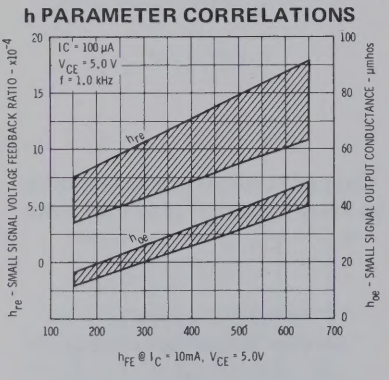


h PARAMETER CORRELATIONS



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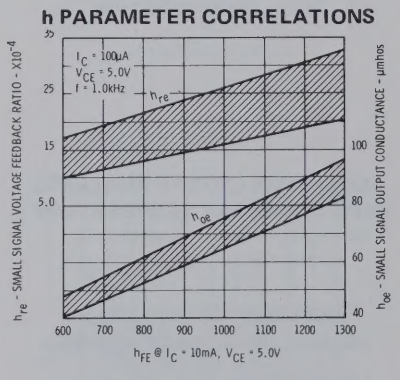

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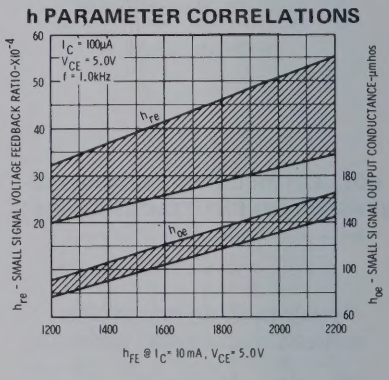

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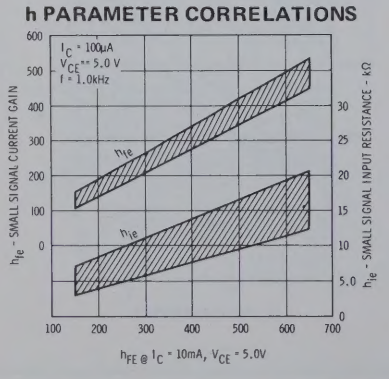

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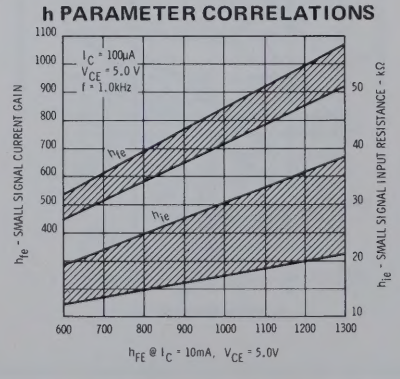

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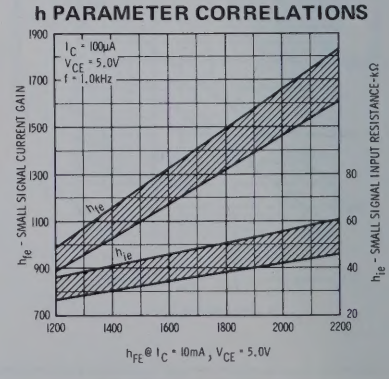
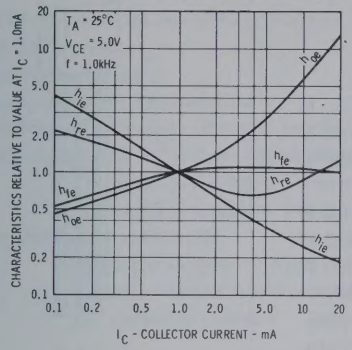


TYPICAL ELECTRICAL CHARACTERISTICS

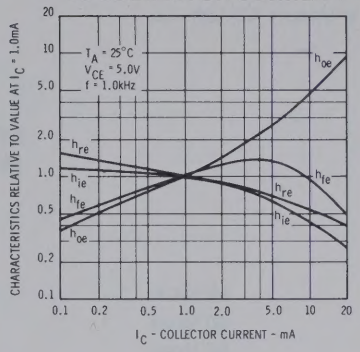
2N5961

COMMON EMITTER CHARACTERISTICS VS COLLECTOR CURRENT



2N5962

COMMON EMITTER CHARACTERISTICS VS COLLECTOR CURRENT



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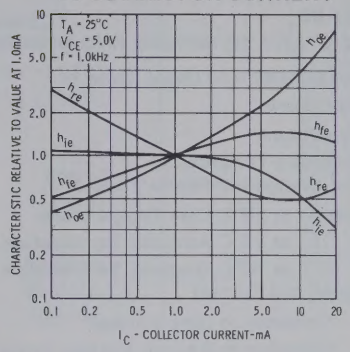
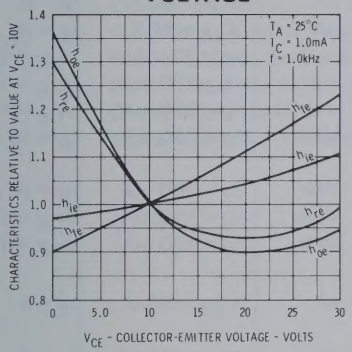
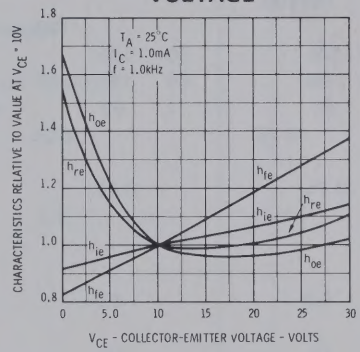
COMMON EMITTER CHARACTERISTICS VS COLLECTOR CURRENT



COMMON EMITTER CHARACTERISTICS VERSUS VOLTAGE



COMMON EMITTER CHARACTERISTICS VERSUS VOLTAGE



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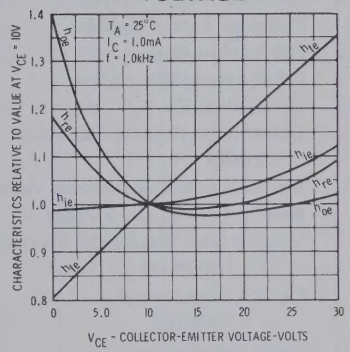
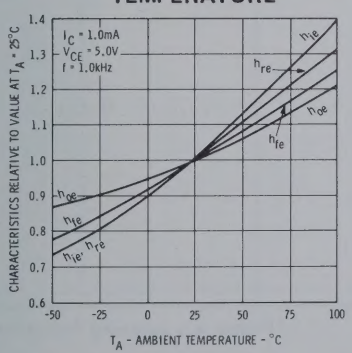
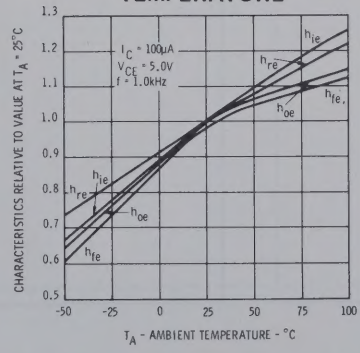


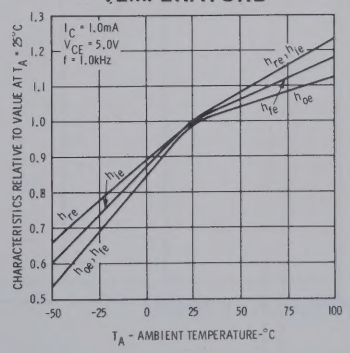
COMMON EMITTER CHARACTERISTICS VERSUS TEMPERATURE



COMMON EMITTER CHARACTERISTICS VERSUS TEMPERATURE



COMMON EMITTER CHARACTERISTICS VERSUS TEMPERATURE

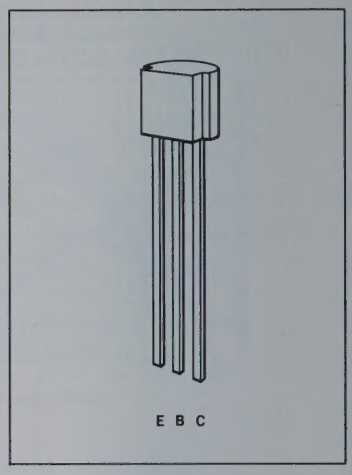


MPSA05 • MPSA06

NPN MEDIUM-POWER DRIVERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- HIGH VOLTAGE . . . . . BV_{CEO} = 60 V (MIN) AT 10 mA (MPSA05)
  . . . . . BV_{CEO} = 80 V (MIN) AT 1.0 mA (MPSA06)
- HIGH GAIN . . . . . h_{FE} = 1.0-200 mA
- LOW VOLTAGE . . . . . $V_{CE(sat)}$ = 0.25 V (MAX) AT 100 mA
- COMPLEMENTARY TO MPSA55 AND MPSA56



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

		MPSA05	MPSA06
V_{CBO}	Collector to Base Voltage	60 Volts	80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	60 Volts	80 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts	4.0 Volts
I_C	DC Collector Current	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPSA05 MIN.	MPSA05 TYP.	MPSA05 MAX.	MPSA06 MIN.	MPSA06 TYP.	MPSA06 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	60			80			Volts	I_C = 1.0 mA, I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			4.0			Volts	I_E = 100 μA, I_C = 0
I_{CBO}	Collector Cutoff Current			100				nA	V_{CB} = 60 V, I_E = 0
I_{CBO}	Collector Cutoff Current						100	nA	V_{CB} = 80 V, I_E = 0
h_{FE}	DC Current Gain	50	125		50	125			I_C = 10 mA, V_{CE} = 1.0 V
h_{FE}	DC Current Gain	50	150		50	150			I_C = 100 mA, V_{CE} = 1.0 V
h_{FE}	DC Current Gain		90			90			I_C = 350 mA, V_{CE} = 1.0 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage			0.25			0.25	Volt	I_C = 100 mA, I_B = 10 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		0.75			0.75		Volt	I_C = 100 mA, I_B = 10 mA
$V_{BE(on)}$	Base to Emitter On Voltage			1.2			1.2	Volts	I_C = 100 mA, V_{CE} = 1.0 V
f_T	Current Gain Bandwidth Product (f = 100 MHz)	50			50			MHz	I_C = 100 mA, V_{CE} = 1.0 V
C_{ob}	Output Capacitance (f = 100kHz)		6.0			6.0		pF	V_{CB} = 10 V, I_E = 0
C_{ib}	Input Capacitance (f = 100 kHz)		15			15		pF	V_{EB} = 0.5 V, I_C = 0

*Planar is a patented Fairchild process

NOTES:

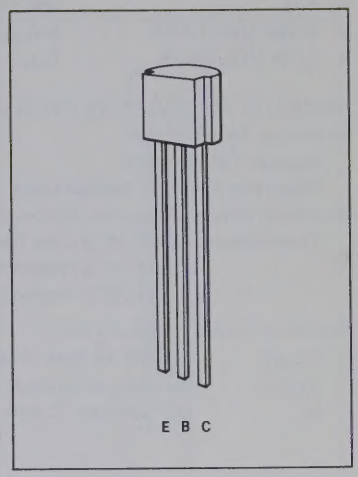
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPSA09

NPN AMPLIFIER

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH VOLTAGE** . . . . . V_{CEO} = 50 V (MIN)
- **HIGH GAIN** . . . . . h_{FE} = 100-600 AT 100 μA
- **LOW NOISE** . . . . . NF = 1.4 dB (TYP) AT 1.0 kHz



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	50 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	50 Volts
I_C	DC Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	50			Volts	I_C = 1.0 mA, I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	50			Volts	I_C = 0.1 mA, I_E = 0
I_{CBO}	Collector Cutoff Current			100	nA	V_{CB} = 25 V, I_E = 0
I_{EBO}	Emitter Cutoff Current			100	nA	V_{BE} = 3.0 V, I_C = 0
h_{FE}	DC Current Gain	100		600		I_C = 0.1 mA, V_{CE} = 5.0 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage			0.9	Volt	I_C = 10 mA, I_B = 1.0 mA
$V_{BE(on)}$	Base to Emitter On Voltage			1.0	Volt	I_C = 1.0 mA, V_{CE} = 5.0 V
f_T	Current Gain Bandwidth Product (f= 20 MHz)	30	80		MHz	I_C = 0.5 mA, V_{CE} = 5.0 V
C_{ob}	Output Capacitance (f = 100 kHz)			5.0	pF	V_{CB} = 5.0 V, I_E = 0
NF	Noise Figure (f = 1.0 kHz)		1.4		dB	I_C = 0.1 mA, V_{CE} = 5.0 V, R_s = 6.8 kΩ

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

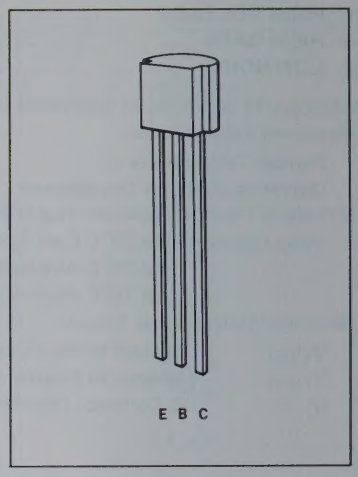
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPSA10 • MPSK10 • MPSK11 • MPSK12

NPN GENERAL PURPOSE TRANSISTORS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- h_{FE} . . . . . See Table 1
- HIGH VOLTAGE . . . BV_{CEO} = 40 V (MIN) AT 1.0 mA
- LOW VOLTAGE . . . C_{ob} = 4.0 pF (MAX) AT 10 V



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{EBO}	Emitter to Base Voltage	4.0 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 Volts
I_C	DC Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	40		Volts	I_C = 1.0 mA, I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		Volts	I_E = 100 μA, I_C = 0
I_{CBO}	Collector Cutoff Current		100	nA	V_{CB} = 30 V, I_E = 0
h_{FE}	DC Current Gain	40	400		I_C = 5.0 mA, V_{CE} = 10 V
f_T	Current Gain Bandwidth Product (f = 20 MHz)	50		MHz	I_C = 5.0 mA, V_{CE} = 10 V
C_{ob}	Output Capacitance (f = 100 kHz)		4.0	pF	V_{CB} = 10 V, I_E = 0

MPSK10, MPSK11 and MPSK12 are three, five and nine transistor kits consisting of MPSA10's with various h_{FE} selections.

Table 1

MPSK10 — Three Transistor Kit

Quantity per Kit	Color Code	h_{FE} @ I_C = 5.0 mAdc, V_{CE} = 10 Vdc Min.	Max.
1	Red	40	400
1	White	80	400
1	Blue	120	300

MPSK11 — Five Transistor Kit

Quantity per Kit	Color Code	h_{FE} @ I_C = 5.0 mAdc, V_{CE} = 10 Vdc Min.	Max.
3	Red	40	400
1	Green	100	200
1	Yellow	150	300

MPSK12 — Nine Transistor Kit

Quantity per Kit	Color Code	h_{FE} @ I_C = 5.0 mAdc, V_{CE} = 10 Vdc Min.	Max.
4	Red	40	400
2	White	80	400
2	Green	100	200
1	Yellow	150	300

NOTES:

*Planar is a patented Fairchild process

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

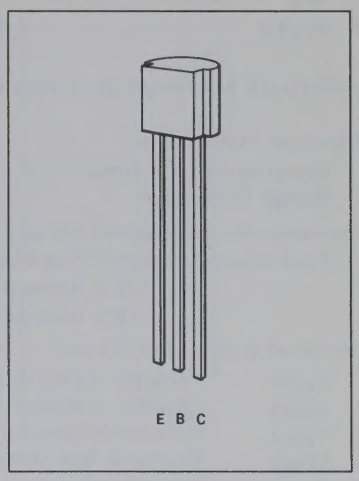
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPSA12

NPN MONOLITHIC DARLINGTON AMPLIFIER

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- h_{FE} . . . . . .20,000 (MIN) @ 10mA
- BV_{CEO} . . . . . .20 V (MIN)



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Operating Junction Temperature	−55°C to + 150°C
Storage Temperature	−55°C to + 150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 Watt
25°C Ambient Temperature	0.625 Watt
70°C Ambient Temperature	0.400 Watt

Maximum Voltages and Current

V_{CEO}	**Collector to Emitter Voltage (Note 4)**	**20 Volts**
V_{EBO}	Emitter to Base Voltage	10 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{FE}	**DC Pulse Current Gain (Note 5)**	**20,000**				I_C = 10mA, V_{CE} = 5.0V
I_{CES}	Collector Reverse Current			100	nA	V_{CE} = 15V, V_{BE} = 0
I_{CBO}	Collector Cutoff Current			100	nA	V_{CB} = 15V, I_E = 0
I_{EBO}	Emitter Cutoff Current			100	nA	V_{EB} = 10V, I_C = 0
h_{fe}	Small Signal Current Gain (f = 1.0kHz)		35			I_C = 10mA, V_{CE} = 5.0V
$V_{CE}(sat)$	Collector Saturation Voltage			1.0	Volts	I_C = 10mA, I_B = 0.01mA
$V_{BE}(on)$	Base Saturation Voltage			1.4	Volts	I_C = 10mA, V_{CE} = 5.0V
C_{obo}	Output Capacitance (f = 100kHz)		8.0		pF	V_{CB} = 10V, I_E = 0
BV_{CES}	Collector-Emitter Breakdown Voltage	20			Volts	I_C = 100μA, I_B = 0

*Planar is a patented Fairchild process

NOTES:

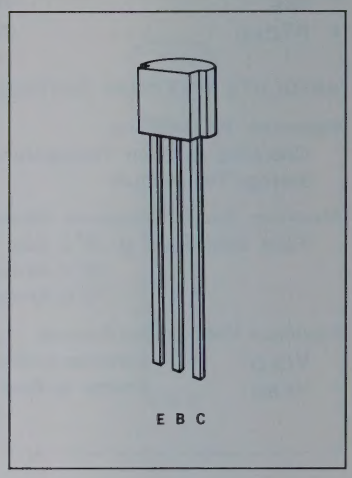
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0mW/°C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse conditions: length = 300μs; duty cycle = 1%.

MPSA13 • MPSA14

NPN MONOLITHIC DARLINGTON AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- h_{FE} . . . . . 20,000 (MIN) AT 10mA
- BV_{CEO} . . . . . 20 V (MIN)



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Operating Junction Temperature	−55°C to + 150°C
Storage Temperature	−55°C to + 150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 Watt
25°C Ambient Temperature	0.625 Watt
70°C Ambient Temperature	0.400 Watt

Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage (Note 4)	30 Volts
V_{CEO}	Collector to Emitter Voltage	30 Volts
V_{CBO}	Collector to Base Voltage	30 Volts
V_{EBO}	Emitter to Base Voltage	10 Volts
I_C	Collector Current	300 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPSA13 MIN.	MPSA13 TYP.	MPSA13 MAX.	MPSA14 MIN.	MPSA14 TYP.	MPSA14 MAX.	UNITS	TEST CONDITIONS
BV_{CES}	Collector to Emitter Breakdown Voltage	30			30			Volts	I_C = 100μA, I_B = 0
I_{CBO}	Collector Cutoff Current			100			100	nA	V_{CB} = 30V, I_E = 0
I_{EBO}	Emitter Cutoff Current			100			100	nA	V_{EB} = 10V, I_C = 0
h_{FE}	DC Current Gain	5,000			10,000				I_C = 10mA, V_{CE} = 5.0V
h_{FE}	**DC Current Gain**	**10,000**			**20,000**				**I_C = 100mA, V_{CE} = 5.0V**
$V_{CE(sat)}$	Collector Saturation Voltage		0.8	1.5		0.8	1.5	Volts	I_C = 100mA, I_B = 0.1mA
$V_{BE(on)}$	Base to Emitter On Voltage		1.25	2.0		1.25	2.0	Volts	I_C = 100mA, V_{CE} = 5.0V
f_t	Current Gain Bandwidth Product (f = 100MHz)	125	200		125	200		MHz	I_C = 10mA, V_{CE} = 5.0V
C_{ob}	Output Capacitance		5.0			5.0		pF	V_{CB} = 10V, I_E = 0
NF	**Noise Figure (f = 1.0kHz)**		**2.0**			**2.0**		**dB**	**I_C = 1.0mA, V_{CE} = 5.0V R_S = 100kΩ**

*Planar is a patented Fairchild process

NOTES:

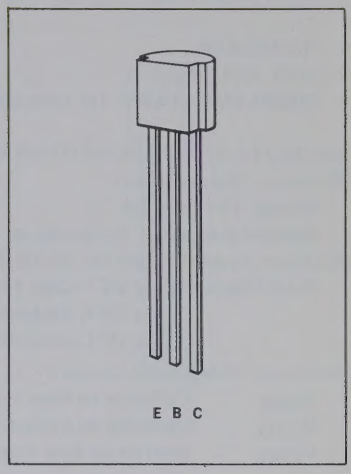
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0mW/°C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse conditions: length = 300μs, duty cycle = 2%.

MPSA20 • MPSK20 • MPSK21 • MPSK22

NPN GENERAL PURPOSE AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- h_{FE} . . . . . See Table 1
- HIGH VOLTAGE . . . . . BV_{CEO} = 40 V (MIN) AT 1.0 mA
- LOW VOLTAGE . . . . . $V_{CE(sat)}$ = 0.25 V (MAX) AT 10 mA
- LOW GAIN . . . . . C_{ob} = 4.0 pF (MAX) AT 10 V
- COMPLEMENTARY TO MPSA70



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{EBO}	Emitter to Base Voltage	4.0 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 Volts
I_C	DC Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	40		Volts	I_C = 1.0 mA, I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0		Volts	I_E = 100 μA, I_C = 0
I_{CBO}	Collector Cutoff Current		100	nA	V_{CB} = 30 V, I_E = 0
h_{FE}	DC Current Gain	40	400		I_C = 5.0 mA, V_{CE} = 10 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.25	Volt	I_C = 10 mA, I_B = 1.0 mA
f_T	Current Gain Bandwidth Product (f = 100 MHz)	125		MHz	I_C = 5.0 mA, V_{CE} = 10 V
C_{ob}	Output Capacitance (f = 100 kHz)		4.0	pF	V_{CB} = 10 V, I_E = 0

MPSK20, MPSK21 and MPSK22 are three, five and nine transistor kits consisting of MPSA20's with various h_{FE} selections.

Table 1

MPSK20 — Three Transistor Kit

Quantity per Kit	Color Code	h_{FE} @ I_C = 5.0 mAdc, V_{CE} = 10 Vdc Min.	Max.
1	Red	40	400
1	White	80	400
1	Blue	120	300

MPSK21 — Five Transistor Kit

Quantity per Kit	Color Code	h_{FE} @ I_C = 5.0 mAdc, V_{CE} = 10 Vdc Min.	Max.
3	Red	40	400
1	Green	100	200
1	Yellow	150	300

MPSK22 — Nine Transistor Kit

Quantity per Kit	Color Code	h_{FE} @ I_C = 5.0 mAdc, V_{CE} = 10 Vdc Min.	Max.
4	Red	40	400
2	White	80	400
2	Green	100	200
1	Yellow	150	300

NOTES:

*Planar is a patented Fairchild process

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

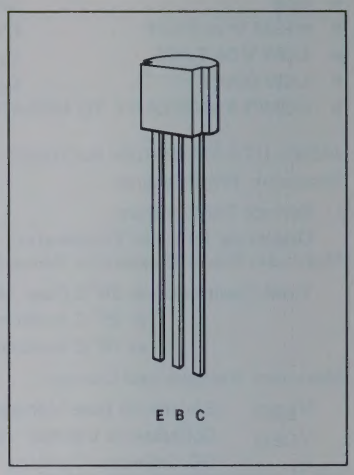
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPSA55 • MPSA56

PNP MEDIUM-POWER DRIVERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH VOLTAGE** . . . . . BV_{CEO} = –40 V (MIN) AT 1.0 mA **MPSA55**
  . . . . . $V_{CE(sat)}$ = –0.25 V (MAX) AT 10 mA **MPSA56**
- **HIGH GAIN** . . . . . h_{FE} = 1.0 TO 200 mA
- **LOW VOLTAGE** . . . . . $V_{CE(sat)}$ = –0.25 V (MAX) AT 100 mA
- **COMPLEMENTARY TO MPSA05 AND MPSA06**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	–55°C to +150°C
Operating Junction Temperature	–55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

		MPSA55	MPSA56
V_{CBO}	Collector to Base Voltage	–60 Volts	–80 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	–60 Volts	–80 Volts
V_{EBO}	Emitter to Base Voltage	–4.0 Volts	–4.0 Volts
I_C	DC Collector Current	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MPSA55 MIN.	MPSA55 TYP.	MPSA55 MAX.	MPSA56 MIN.	MPSA56 TYP.	MPSA56 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	–60			–80			Volts	I_C = 1.0 mA, I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	–4.0			–4.0			Volts	I_E = 100 μA, I_C = 0
I_{CBO}	Collector Cutoff Current			100				nA	V_{CB} = –60 V, I_E = 0
I_{CBO}	Collector Cutoff Current						100	nA	V_{CB} = –80 V, I_E = 0
h_{FE}	DC Current Gain	50	150		50	150			I_C = 10 mA, V_{CE} = –1.0 V
h_{FE}	DC Current Gain	50	125		50	125			I_C = 100 mA, V_{CE} = –1.0 V
h_{FE}	DC Current Gain		80			80			I_C = 350 mA, V_{CE} = –1.0 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		–0.09	–0.25		–0.9	–0.25	Volt	I_C = 100 mA, I_B = 10 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		–0.78			–0.78		Volt	I_C = 100 mA, I_B = 10 mA
$V_{BE(on)}$	Base to Emitter On Voltage		–0.73	–1.2		–0.73	–1.2	Volt	I_C = 100 mA, V_{CE} = –1.0 V
f_T	Current Gain Bandwidth Product (f = 100 MHz)	50	100		50	100		MHz	I_C = 100 mA, V_{CE} = –1.0 V
C_{ob}	Output Capacitance (f = 100 kHz)		6.5			6.5		pF	V_{CB} = –10 V, I_E = 0
C_{ib}	Input Capacitance (f = 100 kHz)		20			20		pF	V_{EB} = –0.5, I_C = 0

NOTES:

*Planar is a patented Fairchild process

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

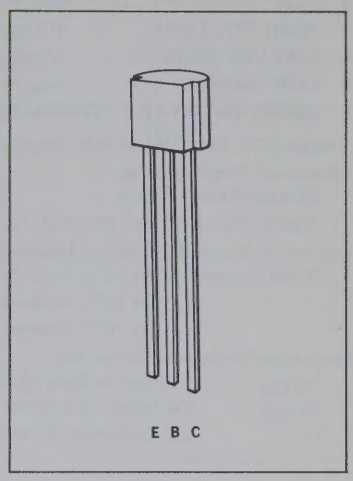
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPSA65 • MPSA66

PNP MONOLITHIC DARLINGTON AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH GAIN** . . . . . h_{FE} = 75,000 (MIN) AT 10 mA
- **MEDIUM VOLTAGE** . . . . . V_{CEO} = −30 V (MIN)
- **LOW NOISE** . . . . . NF = 2.0 dB (TYP) AT 1.0 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation

Total Dissipation at 25°C Case Temperature	1.0 W
Total Dissipation at 25°C Ambient Temperature	0.625 W
at 70°C Ambient Temperature	0.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	−30 Volts
V_{CEO}	**Collector to Emitter Voltage (Note 4)**	**−30 Volts**
V_{EBO}	Emitter to Base Voltage	−10 Volts
I_C	Collector Current	300 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPSA65 MIN.	MPSA65 TYP.	MPSA65 MAX.	MPSA66 MIN.	MPSA66 TYP.	MPSA66 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	−30			−30			Volts	I_C = 10 mA, I_B = 0
I_{CBO}	Collector Cutoff Current			100			100	nA	V_{CB} = −30 V I_E = 0
I_{EBO}	Emitter Cutoff Current			100			100	nA	V_{EB} = −8.0 V, I_C = 0
h_{FE}	**DC Current Gain**	50,000			**75,000**				**I_C = 10 mA, V_{CE} = −5.0 V**
h_{FE}	DC Current Gain	20,000			40,000				I_C = 100 mA, V_{CE} = −5.0 V
$V_{CE}(sat)$	Collector Saturation Voltage		−0.9	−1.5		−0.9	−1.5	Volts	I_C = 100 mA, I_B = 0.1 mA
$V_{BE}(on)$	Base to Emitter On Voltage		−1.45	−2.0		−1.45	−2.0	Volts	I_C = 100 mA, V_{CE} = −5.0 V
f_T	Current Gain Bandwidth Product (f = 100 MHz)	100	175		100	175		MHz	I_C = 10 mA, V_{CE} = −5.0 V
C_{obo}	Collector to Base Capacitance (f = 100 kHz)		2.5			2.5		pF	V_{CB} = −10 V, I_E = 0
NF	**Noise Figure (f = 1.0 kHz)**		**2.0**			**2.0**		**dB**	**I_C = 1.0 mA, V_{CE} = −5.0 V R_S = 100 kΩ**
BV_{CES}	Collector Emitter Breakdown Voltage	−30			−30			Volts	I_C = 100μA, I_B = 0

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

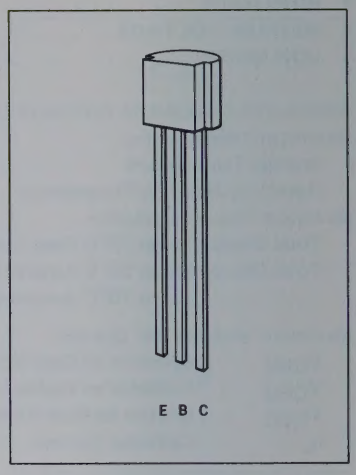
(4) Rating refers to a high current point where collector to emitter voltage is lowest.

MPSA70 • MPSK70 • MPSK71 • MPSK72

PNP GENERAL PURPOSE AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- h_{FE} . . . . . See Table 1
- HIGH VOLTAGE . . . BV_{CEO} = −40 V (MIN) AT 1.0 mA
- LOW VOLTAGE . . . $V_{CE(sat)}$ = −0.25 V (MAX) AT 10 mA
- LOW GAIN . . . . . C_{ob} = 4.0 pF (MAX) AT 10 V
- COMPLEMENTARY TO MPSA20



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{EBO}	Emitter to Base Voltage	−4.0 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−40 Volts
I_C	DC Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	-40		Volts	I_C = 1.0 mA, I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0		Volts	I_E = 100 μA, I_C = 0
I_{CBO}	Collector Cutoff Current		100	nA	V_{CB} = -30 V, I_E = 0
h_{FE}	DC Current Gain	40	400		I_C = 5.0 mA, V_{CE} = -10 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-0.25	Volt	I_C = 10 mA, I_B = 1.0 mA
f_T	Current Gain Bandwidth Product (f = 100 MHz)	125		MHz	I_C = 5.0 mA, V_{CE} = -10 V
C_{ob}	Output Capacitance (f = 100 kHz)		4.0	pF	V_{CB} = -10 V, I_E = 0

MPSK70, MPSK71 and MPSK72 are three, five and nine transistor kits consisting of MPSA70's with various h_{FE} selections

Table 1

MPSK70 — Three Transistor Kit

Quantity per Kit	Color Code	h_{FE} @ I_C = 5.0 mAdc, V_{CE} = −10 Vdc Min.	Max.
1	Red	40	400
1	White	80	400
1	Blue	120	300

MPSK71 — Five Transistor Kit

Quantity per Kit	Color Code	h_{FE} @ I_C = 5.0 mAdc, V_{CE} = −10 Vdc Min.	Max.
3	Red	40	400
1	Green	100	200
1	Yellow	150	300

MPSK72 — Nine Transistor Kit

Quantity per Kit	Color Code	h_{FE} @ I_C = 5.0 mAdc, V_{CE} = −10 Vdc Min.	Max.
4	Red	40	400
2	White	80	400
2	Green	100	200
1	Yellow	150	300

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratins give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

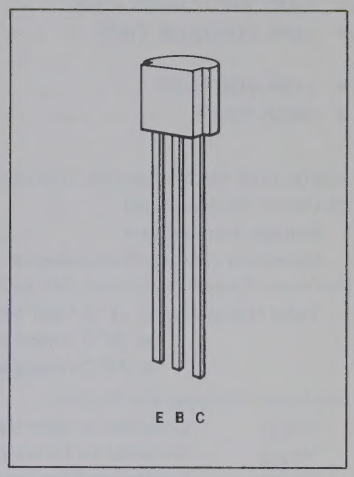
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPSL01

NPN HIGH VOLTAGE AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH VOLTAGE** . . . . . BV_{CEO} = 120 V (MIN)
  . . . . . BV_{CBO} = 140 V (MIN)
- **LOW VOLTAGE** . . . . . $V_{CE(sat)}$ = 0.30 V (MAX) AT 50 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CB}	Collector to Base Voltage	140 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	120 Volts
V_{EB}	Emitter to Base Voltage	5.0 Volts
I_C	DC Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	120		Volts	I_C = 1.0 mA, I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	140		Volts	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		Volts	I_E = 10 μA, I_C = 0
I_{CBO}	Collector Cutoff Current		1.0	μA	V_{CB} = 75 V, I_E = 0
I_{EBO}	Emitter Cutoff Current		100	nA	V_{EB} = 4.0 V, I_C = 0
h_{FE}	DC Current Gain	50	300		I_C = 10 mA, V_{CE} = 5.0 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.20	Volt	I_C = 10 mA, I_B = 1.0 mA
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.30	Volt	I_C = 50 mA, I_B = 5.0 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		1.2	Volts	I_C = 10 mA, I_B = 1.0 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		1.4	Volts	I_C = 50 mA, I_B = 5.0 mA
f_T	Current Gain Bandwidth Product (f = 100 MHz)	60		MHz	I_C = 10 mA, V_{CE} = 10 V
C_{ob}	Output Capacitance (f = 1.0 MHz)		8.0	pF	V_{CB} = 10 V, I_E = 0
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	30			I_C = 1.0 mA, V_{CE} = 10 V

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

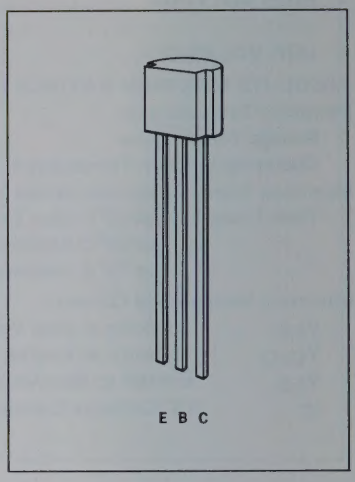
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPSL07 • MPSL08

PNP HIGH-SPEED SWITCHES

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **FAST SWITCHING TIME** . . . . . $t_{on} + t_{off} = 50$ ns (TYP) AT 10 mA
- **LOW STORAGE TIME** . . . . . $\tau_s = 15$ ns (MAX) AT 10 mA MPSL07
  . . . . . $\tau_s = 20$ ns (MAX) AT 10 mA MPSL08
- **LOW VOLTAGE** . . . . . $V_{CE(sat)} = -0.07$ V (TYP) AT 10 mA
- **HIGH GAIN** . . . . . $f_T = 500$ MHz (MIN) AT 10 mA MPSL07
  . . . . . $f_T = 700$ MHz (MIN) AT 10 mA MPSL08



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

		MPSL07	MPSL08
V_{CBO}	Collector to Base Voltage	−6.0 Volts	−12 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−6.0 Volts	−12 Volts
V_{EBO}	Emitter to Base Voltage	−4.5 Volts	−4.5 Volts
I_C	DC Collector Current	80 mA	80 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MPSL07 MIN.	MPSL07 TYP.	MPSL07 MAX.	MPSL08 MIN.	MPSL08 TYP.	MPSL08 MAX.	UNITS	TEST CONDITIONS
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	−6.0			−12			Volts	$I_C = 3.0$ mA, $I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	−6.0			−12			Volts	$I_C = 100\ \mu$A, $V_{BE} = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	−6.0			−12			Volts	$I_C = 100\ \mu$A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.5			−4.5			Volts	$I_E = 100\ \mu$A, $I_C = 0$
I_{CES}	Collector Cutoff Current		1.0	10				nA	$V_{CE} = -3.0$ V, $V_{BE} = 0$
I_{CES}	Collector Cutoff Current					1.0	10	nA	$V_{CE} = -6.0$ V, $V_{BE} = 0$
I_{CES} (T_A = 65°C)	Collector Cutoff Current			5.0				μA	$V_{CE} = -3.0$ V, $V_{BE} = 0$
I_{CES} (T_A = 65°C)	Collector Cutoff Current						5.0	μA	$V_{CE} = -6.0$ V, $V_{BE} = 0$
I_B	Base Current			10				nA	$V_{CE} = -3.0$ V $V_{BE} = 0$
I_B	Base Current						10	nA	$V_{CE} = -6.0$ V, $V_{BE} = 0$
h_{FE}	DC Current Gain	15	40		15	40			$I_C = 1.0$ mA, $V_{CE} = -0.5$ V
h_{FE}	DC Current Gain	30	50	120	30	50	120		$I_C = 10$ mA, $V_{CE} = -3.0$ V
h_{FE}	DC Current Gain	30	35		30	35			$I_C = 50$ mA, $V_{CE} = -1.0$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		−0.07	−0.15		−0.07	−0.15	Volts	$I_C = 10$ mA, $I_B = 1.0$ mA
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		−0.2	−0.5		−0.2	−0.5	Volts	$I_C = 50$ mA, $I_B = 5.0$ mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage	−0.73	−0.79	−0.88	−0.73	−0.79	−0.88	Volts	$I_C = 10$ mA, $I_B = 1.0$ mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		−0.89	−1.5		−0.89	−1.5	Volts	$I_C = 50$ mA, $I_B = 5.0$ mA
f_T	Current Gain Bandwidth Product (f = 100 MHz)	500	1000		500	1000		MHz	$I_C = 10$ mA, $V_{CE} = -5.0$ V
f_T	Current Gain Bandwidth Product (f = 100 MHz)	700	1200		700	1200		MHz	$I_C = 10$ mA, $V_{CE} = -10$ V
C_{ob}	Output Capacitance (f = 140 kHz)		1.9	3.0		1.9	3.0	pF	$V_{CB} = -5.0$ V, $I_E = 0$
C_{ib}	Input Capacitance (f = 140 kHz)		3.6	5.0		3.6	5.0	pF	$V_{EB} = -0.5$ V, $I_C = 0$
t_{on}	Turn-On Time (Figure 1)		15	20		15	20	ns	$I_C = 10$ mA, $I_{B1} = 1.0$ mA
t_{off}	Turn-Off Time (Figure 1)		35	40		35	40	ns	$I_C = 10$ mA, $I_{B1} = I_{B2} = 1.0$ mA
t_s	Charge Storage Time (Figure 2)			15			20	ns	$I_C = 10$ mA, $I_{B1} = I_{B2} = 10$ mA

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

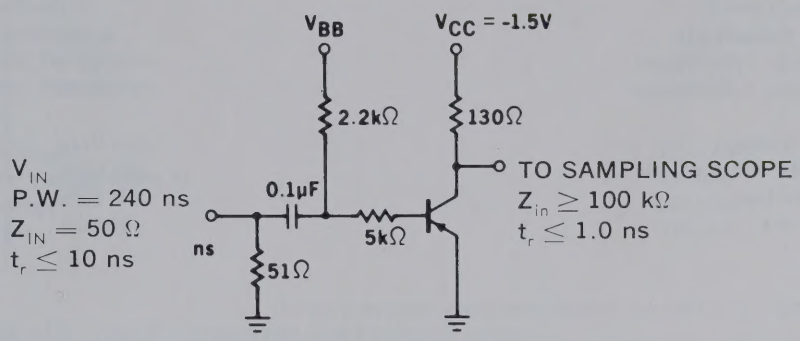
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

Figure 1 TURN-ON AND TURN-OFF TEST CIRCUIT

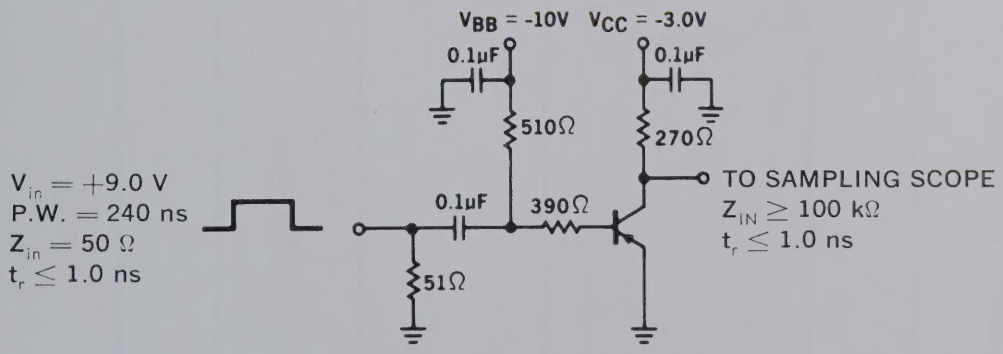


t_{on}
V_{BB} = GROUND
V_{IN} = −5.8 V

t_{off}
V_{BB} = −8.0 V
V_{IN} = +9.8 V

$I_C \approx$ 10 mA, $I_{B1} \approx$ 1.0 mA, $I_{B2} \approx$ 1.0 mA

Figure 2 CHARGE STORAGE TIME TEST CIRCUIT



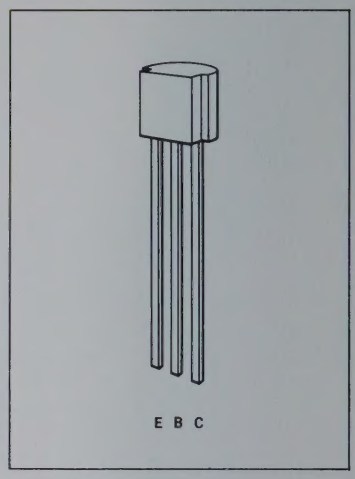
$I_C \approx$ 10 mA, $I_{B1} \approx$ 1.0 mA, $I_{B2} \approx$ −10 mA

MPSL51

PNP HIGH VOLTAGE AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH VOLTAGE** . . . . . $BV_{CEO} = -100$ V (MIN)
  . . . . . $BV_{CBO} = -100$ V (MIN)
- **LOW VOLTAGE** . . . . . $V_{CE(sat)} = -0.30$ V (MAX) AT 50 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	-100 Volts
V_{CEO}	Collector to Emitter Voltage (note 5)	-100 Volts
V_{EBO}	Emitter to Base Voltage	-4.0 Volts
I_C	DC Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	-100		Volts	$I_C = 1.0$ mA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	-100		Volts	$I_C = 100\ \mu$A, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0		Volts	$I_E = 10\ \mu$A, $I_C = 0$
I_{CBO}	Collector Cutoff Current		1.0	μA	$V_{CB} = -50$ V $I_E = 0$
I_{EBO}	Emitter Cutoff Current		100	nA	$V_{BE} = -3.0$ V $I_C = 0$
h_{FE}	DC Current Gain	40	250		$I_C = 50$ mA, $V_{CE} = -5.0$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-0.25	Volt	$I_C = 10$ mA, $I_B = 1.0$ mA
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		-0.30	Volt	$I_C = 50$ mA, $I_B = 5.0$ mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		-1.2	Volt	$I_C = 10$ mA, $I_B = 1.0$ mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		-1.2	Volt	$I_C = 50$ mA, $I_B = 5.0$ mA
f_T	Current Gain Bandwidth Product (f = 100 MHz)	60		MHz	$I_C = 10$ mA, $V_{CE} = -10$ V
C_{ob}	Output Capacitance (f = 1.0 MHz)		8.0	pF	$V_{CB} = -10$ V, $I_E = 0$
h_{fe}	Small Signal Current Gain (f = 1.0 kHz)	20			$I_C = 1.0$ mA, $V_{CE} = -10$ V

NOTES:

*Planar is a patented Fairchild process

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

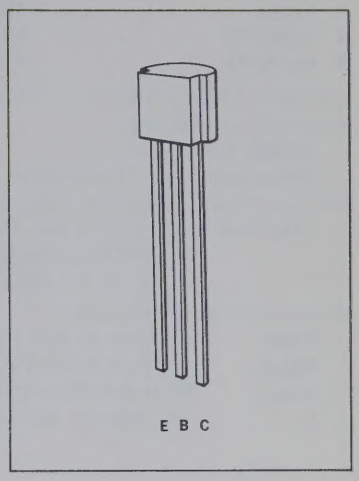
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS2711 • MPS2712

NPN LOW-POWER, SMALL SIGNAL TRANSISTORS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} . . . . . 18 V (MIN)
- h_{FE} . . . . . 75-225 AT 2 mA
- C_{cb} . . . . . 4 pF (MAX)



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	18 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	18 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	DC Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS2711 MIN.	MPS2711 TYP.	MPS2711 MAX.	MPS2712 MIN.	MPS2712 TYP.	MPS2712 MAX.	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current			0.5			0.5	μA	V_{CB} = 18 V, I_E = 0
$I_{CBO}(T_A=100°C)$	Collector Cutoff Current			1.5			1.5	μA	V_{CB} = 18V, I_E = 0
I_{EBO}	Emitter to Base Cutoff Current			0.5			0.5	μA	V_{EB} = 5 V, I_C = 0
h_{FE}	DC Current Gain	30	90		75	225			V_{CE} = 4.5 V, I_C = 2 mA
C_{ob}	Output Capacitance (f = 1 MHz)		4.0			4.0		pF	V_{CB} = 10 V, I_E = 0
h_{fe}	Small Signal Current Gain (f = 1 kHz)	30	120		80	200			V_{CE} = 10 V, I_C = 2 mA

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

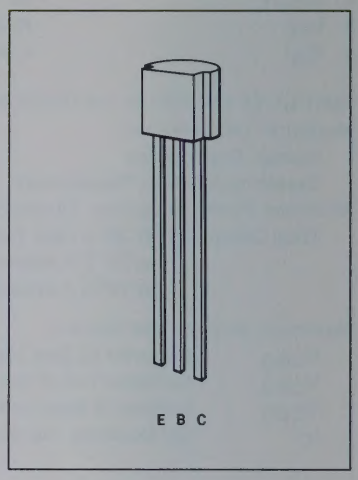
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS2713 • MPS2714

NPN GENERAL PURPOSE LOW-LEVEL SWITCHES

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} . . . . . 18 V (MIN)
- $t_{on}(t_d+t_r)$ . . . . . 13 ns (TYP) AT 10 mA
- $t_{off}(t_s+t_r)$ . . . . . 21 ns (TYP) AT 10 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	18 Volts
V_{CEO}	Collector to Emitter Voltage(Note 4)	18 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	DC Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS2713 MIN.	MPS2713 TYP.	MPS2713 MAX.	MPS2714 MIN.	MPS2714 TYP.	MPS2714 MAX.	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current			0.5			0.5	μA	V_{CB} = 18 V, I_E = 0
I_{CBO} (T_A =100°C)	Collector Cutoff Current			15			15	μA	V_{CB} = 18 V, I_E = 0
I_{EBO}	Emitter Cutoff Current			0.5			0.5	μA	V_{EB} = 5 V, I_C = 0
h_{FE}	DC Current Gain	30	60	90	75	150	225		I_C = 2 mA, V_{CE} = 4.5 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.16	0.3		0.16	0.3	Volt	I_C = 50 mA, I_B = 3 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage	0.6	0.75	1.3	0.6	0.75	1.3	Volts	I_C = 50 mA, I_B = 3 mA
h_{fe}	Small Signal Current Gain (f=1 kHz)	30		120	80		300		I_C = 2 mA, V_{CE} = 4.5 V
f_T	Current Gain Bandwidth Product (f = 100 MHz)		250			250		MHz	I_C = 10 mA, V_{CE} = 10 V
C_{ob}	Output Capacitance (f=100 kHz)		2.5			2.5		pF	V_{CB} = 10 V, I_E = 0
h_{ie}	Input Impedance (F=1 kHz)		3000			3000		Ω	I_C = 0.5 mA, V_{CE} = 1 V
t_d	Delay Time		7.0			7.0		ns	I_C = 10 mA, I_{B1}=3 mA, V_{CC}=10 V
t_r	Rise Time		6.0			6.0		ns	I_C = 10 mA, I_{B1}=3 mA, V_{CC}=10 V
t_s	Storage Time		12			12		ns	I_C = 10 mA, I_{B1} = 3 mA, I_{B2} = 1 mA
t_f	Fall Time		9.0			9.0		ns	V_{CC} = 10 V

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

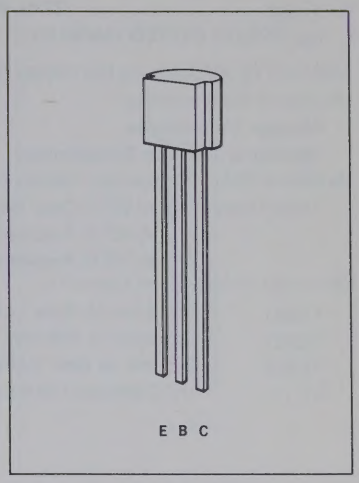
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS2923 • MPS2924 • MPS2925

NPN MEDIUM-SPEED GENERAL PURPOSE AMPLIFIERS AND OSCILLATORS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} . . . . . **25 V (MIN)**
- h_{FE} . . . . . **225-470 AT 2 mA**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	25 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	25 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	DC Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS2923 MIN.	MPS2923 MAX.	MPS2924 MIN.	MPS2924 MAX.	MPS2925 MIN.	MPS2925 MAX.	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current		0.5		0.5		0.5	μA	V_{CB} = 25 V, I_E = 0
I_{CBO}(T_A= 100°C)	Collector Cutoff Current		15		15		15	μA	V_{CB} = 25 V, I_E = 0
I_{EBO}	Emitter Cutoff Current		0.5		0.5		0.5	μA	V_{EB} = 5 V,
h_{fe}	Small Signal Current Gain (f = 1 kHz)	90	180	150	300	235	470		V_{CE} = 10 V, I_C = 2 mA
C_{ob}	Collector Capacitance (f=1 MHz)		12		12		12	pF	V_{CB} = 10 V, I_E = 0

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

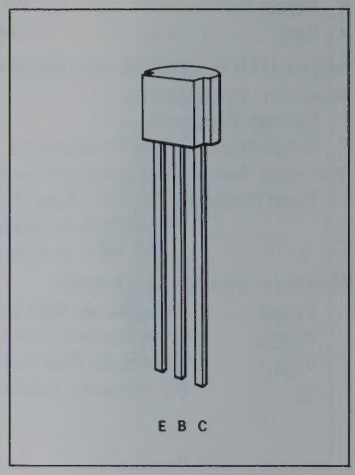
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS2926 • MPS3721

NPN SMALL SIGNAL, LOW-POWER AUDIO TRANSISTORS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} . . . . . 25 V (MIN)
- h_{fe} COLOR CODED RANGES



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	18 Volts
V_{CEO}	Collector to Emitter Voltage(Note 4)	18 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	DC Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS2926 MIN.	MPS2926 TYP.	MPS2926 MAX.	MPS3721 MIN.	MPS3721 TYP.	MPS3721 MAX.	UNITS	TEST CONDITIONS
I_{CBO}	Collector Cutoff Current			0.5			0.5	μA	V_{CB} = 18 V, I_E = 0
$I_{CBO}(T_A=100°C)$	Collector Cutoff Current			15			15	μA	V_{CB} = 18 V, I_E = 0
I_{EBO}	Emitter Cutoff Current			0.5			0.5	μA	V_{EB} = 5 V, I_C = 0
f_T	Current Gain Bandwidth Product		300					MHz	I_C = 4 mA, V_{CE} = 5 V
C_{ob}	Output Capacitance (f=1 MHz)			3.5			3.5	pF	V_{CB} = 10 V, I_E = 0
h_{fe}	Small Signal Current Gain (f=1 kHz)	35		470	60		660		V_{CE} = 10 V, I_C = 2 mA

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

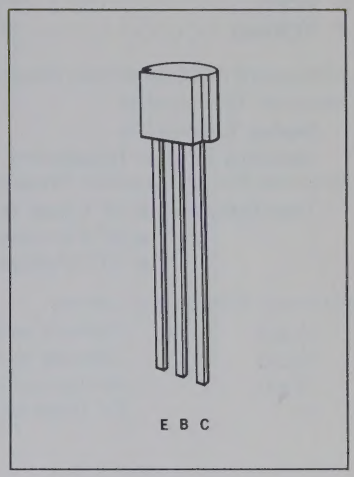
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS3392 • MPS3393 • MPS3394 • MPS3395

NPN GENERAL PURPOSE TRANSISTORS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} . . . . . 25 V (MIN)
- h_{FE} . . . . . 150-300 AT 2 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	25 Volts
V_{CEO}	Collector to Emitter Voltage(Note 4)	25 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	DC Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS3392 MIN.	MPS3392 MAX.	MPS3393 MIN.	MPS3393 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	25		25		Volts	I_C = 1 mA, I_B = 0
I_{CBO}	Collector Cutoff Current		0.1		0.1	μA	V_{CB} = 18 V, I_E = 0
I_{EBO}	Emitter to Cutoff Current		0.1		0.1	μA	V_{EB} = 5 V, I_C = 0
h_{FE}	DC Current Gain	150	300	90	180		V_{CE} = 4.5 V, I_C = 2 mA
C_{ob}	Output Capacitance (f = 1 MHz)		3.5		3.5	pF	V_{CB} = 10 V, I_E = 0
h_{fe}	Small Signal Current Gain (f = 1 kHz)	150	500	90	400		V_{CE} = 4.5 V, I_C = 2 mA

SYMBOL	CHARACTERISTIC	MPS3394 MIN.	MPS3394 MAX.	MPS3395 MIN.	MPS3395 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	25		25		Volts	I_C = 1 mA, I_B = 0
I_{CBO}	Collector Cutoff Current		0.1		0.1	μA	V_{CB} = 18 V, I_E = 0
I_{EBO}	Emitter Cutoff Current		0.1		0.1	μA	V_{EB} = 5 V, I_C = 0
h_{FE}	DC Current Gain	55	110	150	500		V_{CE} = 4.5 V, I_C = 2 mA
C_{ob}	Output Capacitance (f = 1 MHz)		3.5		3.5	pF	V_{CB} = 10 V, I_E = 0
h_{fe}	Small Signal Current Gain (f = 1 kHz)	55	300	150	800		V_{CE} = 4.5 V, I_C = 2 mA

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

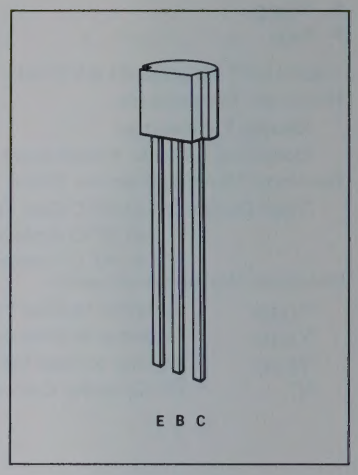
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS3702 • MPS3703

PNP LOW-POWER, LARGE SIGNAL AUDIO TRANSISTORS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} . . . . . −30 V (MIN)
- $V_{CE(sat)}$ . . . . . −0.25 V (MAX) AT 50 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

		MPS3702	MPS3703
V_{CBO}	Collector to Base Voltage	−40 Volts	−50 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	−25 Volts	−30 Volts
V_{EBO}	Emitter to Base Voltage	−5.0 Volts	−5.0 Volts
I_C	DC Collector Current	200 mA	200 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS3702 MIN.	MPS3702 TYP.	MPS3702 MAX.	MPS3703 MIN.	MPS3703 TYP.	MPS3703 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	−25			−30			Volts	I_C = 10 mA, I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	−40			−50			Volts	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0			−5.0			Volts	I_E = 100 μA, I_C = 0
I_{CBO}	Collector Cutoff Current			100			100	nA	V_{CB} = −20 V, I_E = 0
I_{EBO}	Emitter Cutoff Current			100			100	nA	V_{BE} = − 3 V, I_C = 0
h_{FE}	DC Current Gain	60		300	30		150		I_C = 50 mA, V_{CE} = −5 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage			−0.25			−0.25	Volt	I_C = 50 mA, I_B = 5 mA
$V_{BE(on)}$	Base to Emitter On Voltage	−0.6		−1.0	−0.6		−1.0	Volt	I_C = 50 mA, V_{CE} = −5 V
f_T	Current Gain Bandwidth Product (f = 20 MHz)	100			100			MHz	I_C = 50 mA, V_{CE} = −5 V
C_{ob}	Output Capacitance (f=1 MHz)			12			12	pF	V_{CB} = -10 V,

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

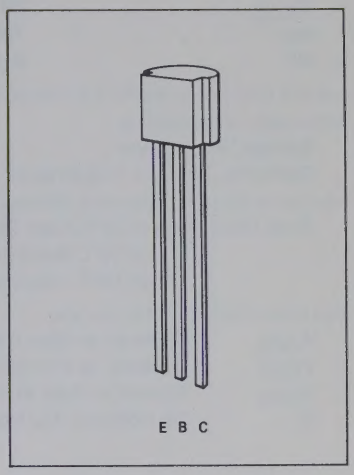
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS3704 • MPS3705 • MPS3706

NPN LOW-POWER, LARGE-SIGNAL AUDIO TRANSISTORS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} . . . . . 30 V (MIN)
- h_{FE} . . . . . 100-300 AT 50 mA
- $V_{CE(sat)}$ . . . . . 0.6 V (MAX) AT 100 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

		MPS3704	MPS3705	MPS3706
V_{CBO}	Collector to Base Voltage	50 Volts	50 Volts	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts	30 Volts	20 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts	5.0 Volts
I_C	DC Collector Current	600 mA	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS3704 MIN.	MPS3704 MAX.	MPS3705 MIN.	MPS3705 MAX.	MPS3706 MIN.	MPS3706 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	30		30		20		Volts	I_C = 10 mA, I_E = 0
BV_{CBO}	Collector to Base Breakdown Voltage	50		50		40		Volts	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		5.0		Volts	I_E = 100 μA, I_C = 0
I_{CBO}	Collector Cutoff Current		100		100		100	nA	V_{CB} = 20 V, I_E = 0
I_{EBO}	Emitter Cutoff Current		100		100		100	nA	V_{BE} = 3 V, I_C = 0
h_{FE}	DC Current Gain	100	300	50	150	30	600		I_C = 50 mA, V_{CE} = 2 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.6		0.8		1.0	Volt	I_C = 100 mA, I_B = 5 mA
$V_{BE(on)}$	Base to Emitter On Voltage	0.5	1.0	0.5	1.0	0.5	1.0	Volt	I_C = 100 mA, V_{CE} = 2 V
f_T	Current Gain Bandwidth Product (f = 20 MHz)	100		100		100		MHz	I_C = 50 mA, V_{CE} = 2 V
C_{ob}	Output Capacitance (f=1 MHz)		12		12		12	pF	V_{CB} = 10 V, I_E = 0

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

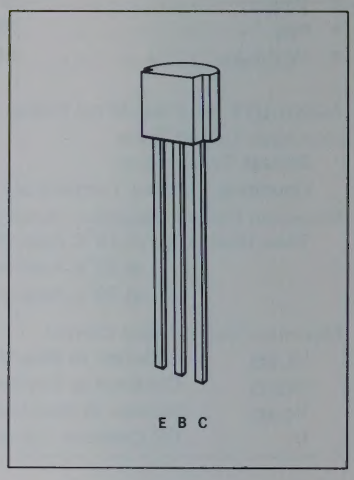
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS3707·MPS3708·MPS3709·MPS3710·MPS3711

NPN GENERAL-PURPOSE, LOW-LEVEL AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- V_{CEO} . . . . . 30 V (MIN)
- h_{FE} . . . . . 100-400 AT 100 μA
- NF . . . . . 5 dB (MAX) WIDEBAND



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	30 Volts
V_{EBO}	Emitter to Base Voltage	6.0 Volts
I_C	DC Collector Current	30 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS3707 MIN.	MPS3707 MAX.	MPS3708 MIN.	MPS3708 MAX.	MPS3709 MIN.	MPS3709 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	30		30		30		Volts	I_C = 1 mA, I_B = 0
I_{CBO}	Collector Cutoff Current		100		100		100	nA	V_{CB} = 20 V, I_E = 0
I_{EBO}	Emitter Cutoff Current		100		100		100	nA	V_{EB} = 6 V, I_C = 0
h_{FE}	DC Current Gain	100	400						I_C = 100 μA, V_{CE} = 5 V
h_{FE}	DC Current Gain			45	660	45	165		I_C = 1 mA, V_{CE} = 5 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		1.0		1.0		1.0	Volt	I_C = 10 mA, I_B = 0.5 mA
$V_{BE(on)}$	Base to Emitter Voltage	0.5	1.0	0.5	1.0	0.5	1.0	Volt	I_C = 1 mA, V_{CE} = 5 V
h_{fe}	Small Signal Current Gain (f = 1 kHz)	100	550						I_C = 100 μA, V_{CE} = 5 V
h_{fe}	Small Signal Current Gain (f = 1 kHz)			45	800	45	250		I_C = 1 mA, V_{CE} = 5 V
NF	Noise Figure (Noise Bandwidth = 15.7 kHz)		5.0					dB	V_{CE} = 5 V, I_C = 100 μA, R_G = 5 kΩ

SYMBOL	CHARACTERISTIC	MPS3710 MIN.	MPS3710 MAX.	MPS3711 MIN.	MPS3711 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	30		30		Volts	I_C = 1 mA, I_B = 0
I_{CBO}	Collector Cutoff Current		100		100	nA	V_{CB} = 20 V, I_E = 0
I_{EBO}	Emitter Cutoff Current		100		100	nA	V_{EB} = 6 V, I_C = 0
h_{FE}	DC Current Gain	90	330	180	660		I_C = 1 mA, V_{CE} = 5 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		1.0		1.0	Volt	I_C = 10 mA, I_B = 0.5 mA
$V_{BE(on)}$	Base to Emitter Voltage	0.5	1.0	0.5	1.0	Volt	I_C = 1 mA, V_{CE} = 5 V
h_{fe}	Small Signal Current Gain (f = 1 kHz)	90	450	180	800		I_C = 1 mA, V_{CE} = 5 V

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

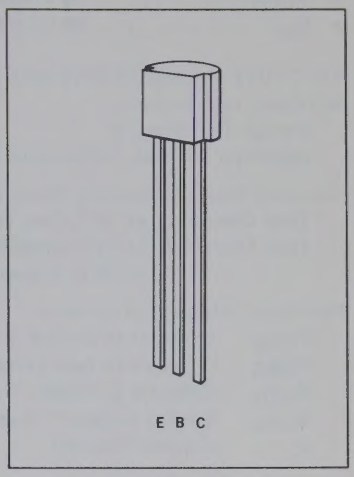
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS5172

NPN GENERAL-PURPOSE, LOW-LEVEL AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH GAIN** . . . . . h_{FE} = 100 - 500 AT 10 mA
- **LOW VOLTAGE** . . . . . $V_{CE(sat)}$ = 0.25 V (MAX) AT 10 mA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	25 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	25 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts
I_C	DC Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	25			Volts	I_C = 10 mA, I_B = 0
I_{CES}	Collector Cutoff Current			100	nA	V_{CE} = 25 V, V_{BE} = 0
I_{CBO}	Collector Cutoff Current			100	nA	V_{CB} = 25 V, I_E = 0
I_{CBO} (T_A = 100°C)	Collector Cutoff Current			10	μA	V_{BC} = 25 V, I_E = 0
I_{EBO}	Emitter Cutoff Current			100	nA	V_{BE} = 5.0 V, I_C = 0
h_{FE}	DC Current Gain	100		500		I_C = 10 mA, V_{CE} = 10 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage			0.25	Volts	I_C = 10 mA, I_B = 1.0 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		0.75		Volts	I_C = 10 mA, I_B = 1.0 mA
$V_{BE(on)}$	Base to Emitter On Voltage	0.5		1.2	Volts	I_C = 10 mA, V_{CE} = 10 V
f_T	Current Gain Bandwidth Product		120		MHz	I_C = 2.0 mA, V_{CE} = 5.0V
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)	1.6		10	pF	V_{CB} = 0 I_E = 0
h_{fe}	Small-Signal Current Gain (f = 1.0 kHz)	100		750		I_C = 10 mA, V_{CE} = 10 V

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

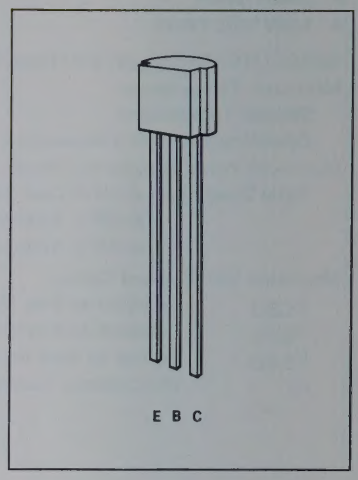
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS6511

NPN IF AMPLIFIER

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- V_{CEO} . . . . . 20 V (MIN)
- G_{pe} . . . . . 30 dB (MIN) AT 45 MHz



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
Total Dissipation at 25°C Ambient Temperature	0.625 W
at 70°C Ambient Temperature	0.400 W

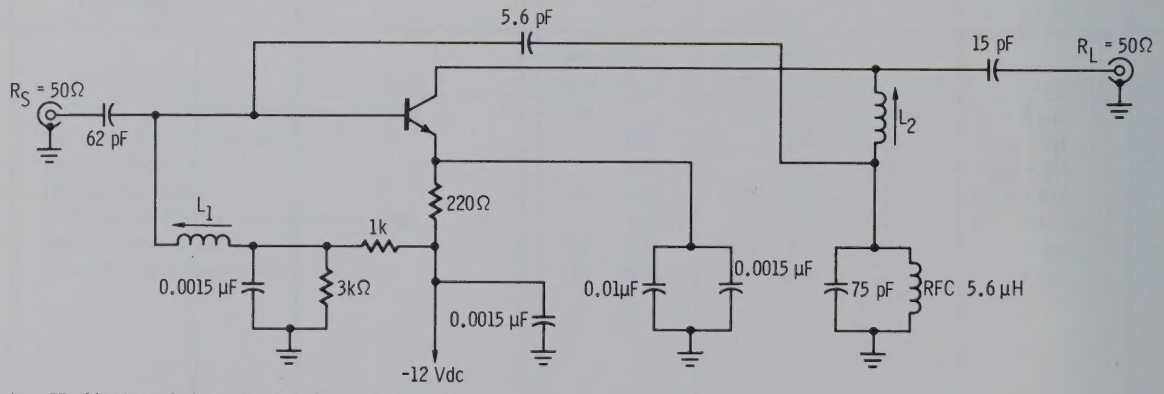
Maximum Voltages and Current

V_{CES}	Collector to Emitter Voltage	30 Volts
V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	20 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts
I_C	Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	MAX.	UNITS	TEST CONDITIONS
BV_{CES}	Collector to Emitter Breakdown Voltage (Note 5)	30		Volts	I_C = 10 mA, V_{BE} = 0
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 5)	20	50	Volts	I_C = 500 μA, I_B = 0
I_{CBO}	Collector Cutoff Current		50	nA	V_{CB} = 15 V, I_E = 0
I_{CBO}(60°C)	Collector Cutoff Current		1.0	μA	V_{CB} = 15 V, I_E = 0
h_{FE}	DC Current Gain	25			I_C = 10 mA, V_{CE} = 10 V
C_{obo}	Output Capacitance (f = 100 kHz)		2.5	pF	V_{CB} = 10 V, I_E = 0
G_{pe}	Power Gain (f = 45 MHz)(Figure 1)	30		dB	I_C = 10 mA, V_{CC} = 12 V

FIGURE 1 – 45 MHz POWER GAIN TEST CIRCUIT



L_1 = 5T #26 WIRE, CLOSE WOUND, 1/4" ID 0.15 -0.20 μH
Q_u = 100 NOMINAL

L_2 = 11T #26 WIRE, CLOSE WOUND, 1/4" I.D. 0.6 - 0.9 μH
Q_u = 80 NOMINAL

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

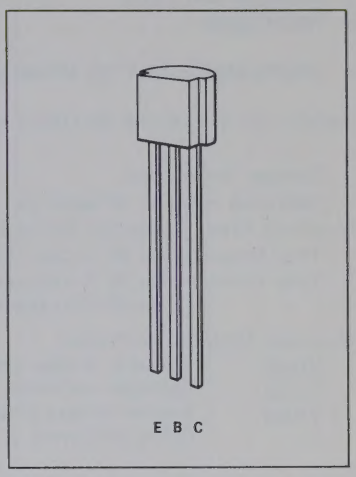
MPS6512 • MPS6513

NPN GENERAL PURPOSE AUDIO AND LOW FREQUENCY AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- MEDIUM VOLTAGE . . . . . BV_{CEO} = 30 V (MIN)
- HIGH GAIN . . . . . h_{FE} = 90-180 AT 2.0 mA
  . . . . . h_{FE} = 60 (MIN) AT 100 mA
- COMPLEMENTARY TO MPS6516 • MPS6517

2N3566
NPN
AMP



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperature	
Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C
Maximum Power Dissipation (Notes 2 and 3)	
Total Dissipation at 25°C Case Temperature	1.0 W
Total Dissipation at 25°C Ambient Temperature	0.625 W
at 70°C Ambient Temperature	0.400 W
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	40 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	30 Volts
V_{EBO} Emitter to Base Voltage	4.0 Volts
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS6512 MIN.	MPS6512 TYP.	MPS6512 MAX.	MPS6513 MIN.	MPS6513 TYP.	MPS6513 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	**Collector to Emitter Breakdown Voltage**	**30**			**30**			**Volts**	**I_C = 500 μA, I_B = 0**
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			4.0			Volts	I_E = 10 μA, I_C = 0
I_{CBO}	Collector Cutoff Current			50			50	nA	V_{CB} = 30 V, I_E = 0
$I_{CBO}(60°C)$	Collector Cutoff Current			1.0			1.0	μA	V_{CB} = 30 V, I_E = 0
h_{FE}	**DC Current Gain**	**50**		100	**90**		**180**		**I_C = 2.0 mA, V_{CE} = 10 V**
h_{FE}	**DC Pulse Current Gain (Note 5)**	30			**60**				**I_C = 100 mA, V_{CE} = 10 V**
$V_{CE}(sat)$	Collector Saturation Voltage			0.5			0.5	Volt	I_C = 50 mA, I_B = 5.0 mA
C_{obo}	Output Capacitance (f=100 kHz)			3.5			3.5	pF	V_{CB} = 10 V, I_E = 0
f_T	Current Gain Bandwidth Product (f = 100 MHz)		250			250		MHz	I_C = 2.0 mA, V_{CE} = 10 V
f_T	Current Gain Bandwidth Product (f = 100 MHz)		330			330		MHz	I_C = 10 mA, V_{CE} = 10 V
NF	Wideband Noise Figure		2.0			2.0		db	I_C = 10μA, V_{CE}=5.0V, R_S=10KΩ Power Bandwidth 15.7kHz, 3db Points at 10Hz & 10kHz

*Planar is a patented Fairchild process

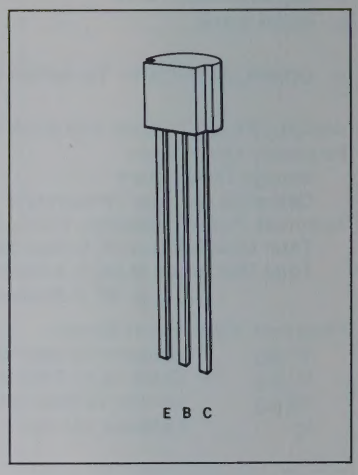
NOTES:
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS6514 • MPS6515

NPN GENERAL PURPOSE AUDIO AND LOW FREQUENCY AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- MEDIUM VOLTAGE . . . . . V_{CEO} = 25 V (MIN)
- HIGH GAIN . . . . . h_{FE} = 250-500 AT 2.0 mA
  . . . . . h_{FE} = 150 (MIN) AT 100 mA
- COMPLEMENTARY TO MPS6518 • MPS6519



ABSOLUTE MAXIMUM RATINGS (Note 1)

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C
Maximum Power Dissipation (Notes 2 and 3)	
Total Dissipation at 25°C Case Temperature	1.0 W
Total Dissipation at 25°C Ambient Temperature	0.625 W
at 70°C Ambient Temperature	0.400 W
Maximum Voltages and Current	
V_{CBO} Collector to Base Voltage	40 Volts
V_{CEO} Collector to Emitter Voltage (Note 4)	25 Volts
V_{EBO} Emitter to Base Voltage	4.0 Volts
I_C Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS6514 MIN.	MPS6514 TYP.	MPS6514 MAX.	MPS6515 MIN.	MPS6515 TYP.	MPS6515 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	**Collector to Emitter Breakdown Voltage**	**25**			**25**			**Volts**	**I_C = 500 μA, I_B = 0**
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			4.0			Volts	I_E = 10 μA, I_C = 0
I_{CBO}	Collector Cutoff Current			50			50	nA	V_{CB} = 30 V, I_E = 0
I_{CBO}(60°C)	Collector Cutoff Current			1.0			1.0	μA	V_{CB} = 30 V, I_E = 0
h_{FE}	**DC Current Gain**	150		300	**250**		**500**		**I_C = 2.0 mA, V_{CE} = 10 V**
h_{FE}	**DC Pulse Current Gain (Note 5)**	90			**150**				**I_C = 100 mA, V_{CE} = 10 V**
V_{CE}(sat)	Collector Saturation Voltage			0.5			0.5	Volt	I_C = 50 mA, I_B = 5.0 mA
C_{obo}	Output Capacitance (f=100 kHz)			3.5			3.5	pF	V_{CB} = 10 V, I_E = 0
f_T	Current Gain Bandwidth Product (f=100 MHz)		390			390		MHz	I_C = 2.0 mA, V_{CE} = 10 V
f_T	Current Gain Bandwidth Product (f=100 MHz)		480			480		MHz	I_C = 10 mA, V_{CE} = 10 V
NF	Wideband Noise Figure		2.0			2.0		db	I_C = 10μA, V_{CE}=5.0V, R_S=10KΩ Power Bandwidth 15.7kHz, 3db Points at 10Hz & 10kHz

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

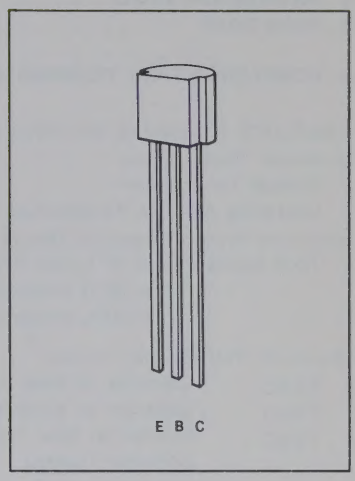
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS6516 • MPS6517

PNP GENERAL PURPOSE AUDIO AND LOW FREQUENCY AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **MEDIUM VOLTAGE** . . . . . V_{CEO} = -40 V (MIN)
- **MEDIUM GAIN** . . . . . h_{FE} = 90-180 AT 2.0 mA
  . . . . . h_{FE} = 60 (MIN) AT 100 mA
- **COMPLEMENTARY TO MPS6512 • MPS6513**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
Total Dissipation at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.4 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	-40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-40 Volts
V_{EBO}	Emitter to Base Voltage	-4.0 Volts
I_C	Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS6516 MIN.	MPS6516 TYP.	MPS6516 MAX.	MPS6517 MIN.	MPS6517 TYP.	MPS6517 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	**Collector to Emitter Breakdown Voltage**	**-40**			**-40**			**Volts**	**I_C = 500 μA, I_B = 0**
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0			-4.0			Volts	I_E = 10 μA, I_C = 0
I_{CBO}	Collector Cutoff Current			50			50	nA	V_{CB} = -30 V, I_E = 0
I_{CBO}(60°C)	Collector Cutoff Current			1.0			1.0	μA	V_{CB} = -30 V, I_E = 0
h_{FE}	**DC Current Gain**	50		100	**90**		**180**		**I_C = 2.0 mA, V_{CE} = -10 V**
h_{FE}	**DC Pulse Current Gain (Note 5)**	30			**60**				**I_C = 100 mA, V_{CE} = -10 V**
V_{CE}(sat)	Collector Saturation Voltage			-0.5			-0.5	Volt	I_C = 50 mA, I_B = 5.0 mA
C_{obo}	Output Capacitance (f=100 kHz)			4.0			4.0	pF	V_{CB} = -10 V, I_E = 0
f_T	Current Gain Bandwidth Product (f = 100 MHz)		200			200		MHz	I_C = 2.0 mA, V_{CE} = -10 V
f_T	Current Gain Bandwidth Product (f = 100 MHz)		270			270		MHz	I_C = 10 mA, V_{CE} = -10 V

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

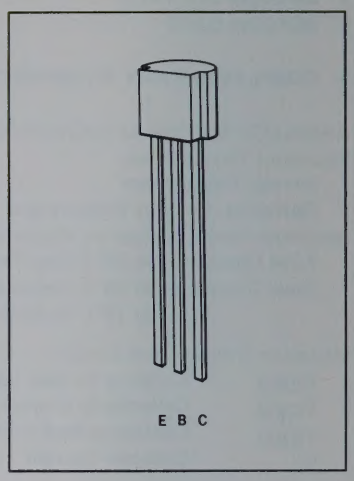
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS6518 • MPS6519

PNP GENERAL PURPOSE AUDIO AND LOW FREQUENCY AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **MEDIUM VOLTAGE** . . . . . V_{CEO} = -40 V (MIN)
- **HIGH GAIN** . . . . . h_{FE} = 250-500 AT 2.0 mA
  . . . . . h_{FE} = 150 (MIN) AT 100 mA
- **COMPLEMENTARY TO MPS6514 • MPS6515**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	-40 Volts	-25 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-40 Volts	-25 Volts
V_{EBO}	Emitter to Base Voltage	-4.0 Volts	-4.0 Volts
I_C	Collector Current	100 mA	100 mA

ELECTRICAL CHARACTERISTICS (25° Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS6518 MIN.	MPS6518 TYP.	MPS6518 MAX.	MPS6519 MIN.	MPS6519 TYP.	MPS6519 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	**Collector to Emitter Breakdown Voltage**	**-40**			**-25**			**Volts**	**I_C = 500 μA, I_B = 0**
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0			-4.0			Volts	I_E = 10 μA, I_C = 0
I_{CBO}	Collector Cutoff Current						50	nA	V_{CB} = -20 V, I_E = 0
I_{CBO}	Collector Cutoff Current			50				nA	V_{CB} = -30 V, I_E = 0
I_{CBO}(60°C)	Collector Cutoff Current			1.0				μA	V_{CB} = -30 V, I_E = 0
I_{CBO}(60°C)	Collector Cutoff Current						1.0	μA	V_{CB} = -20 V, I_E = 0
h_{FE}	**DC Current Gain**	150		300	**250**		**500**		**I_C = 2.0 mA, V_{CE} = -10 V,**
h_{FE}	**DC Pulse Current Gain (Note 5)**	90			**150**				**I_C = 100 mA, V_{CE} = -10 V**
V_{CE}(sat)	Collector Saturation Voltage			-0.5			-0.5	Volt	I_C = 50 mA, I_B = 5.0 mA,
C_{obo}	Output Capacitance (f=100 kHz)			4.0			4.0	pF	V_{CB} = -10 V, I_E = 0
f_T	Current Gain Bandwidth Product (f = 100 MHz)		340			340		MHz	I_C = 2.0 mA, V_{CE} = -10 V
f_T	Current Gain Bandwidth Product (f = 100 MHz)		420			420		MHz	I_C = 10 mA, V_{CE} = -10 V,

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C): junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

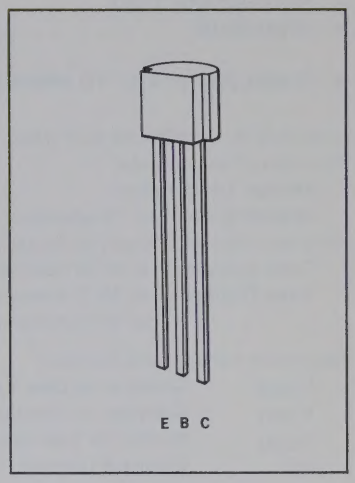
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS6520 • MPS6521

NPN GENERAL PURPOSE AUDIO AND LOW FREQUENCY AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **MEDIUM VOLTAGE** . . . . . BV_{CEO} = 25 V (MIN)
- **HIGH GAIN** . . . . . h_{FE} = 150 (MIN) AT 100 μA
  . . . . . h_{FE} = 300-600 AT 2.0 mA
- **COMPLEMENTARY TO MPS6522 • MPS6523**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
Total Dissipation at 25°C Ambient Temperature	0.625 W
at 70°C Ambient Temperature	0.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	40 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	25 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS6520 MIN.	MPS6520 TYP.	MPS6520 MAX.	MPS6521 MIN.	MPS6521 TYP.	MPS6521 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	**Collector to Emitter Breakdown Voltage**	**25**			**25**			**Volts**	**I_C = 500 μA, I_B = 0**
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			4.0			Volts	I_E = 10 μA, I_C = 0
I_{CBO}	Collector Cutoff Current			50			50	nA	V_{CB} = 30 V, I_E = 0
$I_{CBO}(60°C)$	Collector Cutoff Current			1.0			1.0	μA	V_{CB} = 30 V, I_E = 0
h_{FE}	**DC Current Gain**	**100**			**150**				**I_C = 100 μA, V_{CE} = 10 V**
h_{FE}	**DC Current Gain**	200		400	**300**		**600**		**I_C = 2.0 mA, V_{CE} = 10 V**
$V_{CE}(sat)$	Collector Saturation Voltage			0.5			0.5	Volt	I_C = 50 mA, I_B = 5.0 mA
C_{obo}	Output Capacitance (f=100 kHz)			3.5			3.5	pF	V_{CB} = 10 V, I_E = 0
f_T	Current Gain Bandwidth Product (f = 100 MHz)		390			390		MHz	I_C = 2.0 mA, V_{CE} = 10 V
f_T	Current Gain Bandwidth Product (f = 100 MHz)		480			480		MHz	I_C = 10 mA, V_{CE} = 10 V
NF	Noise Figure (Wideband)		1.8	3.0		1.8	3.0	db	I_C = 10μA, V_{CE}=5.0V, R_S=10KΩ Power Bandwidth −15.7kHz, 3db Points @ 10Hz and 10kHz

*Planar is a patented Fairchild process

NOTES

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations

(3) These ratings give a maximum junction temperature of 150 °C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

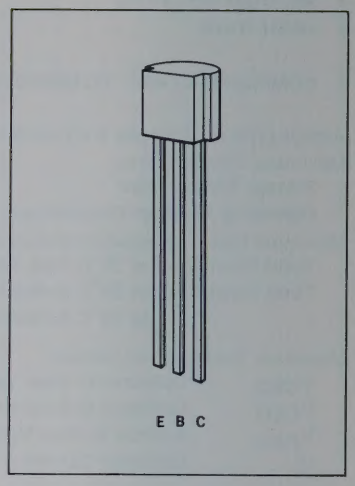
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS6522 • MPS6523

PNP GENERAL PURPOSE AUDIO AND LOW FREQUENCY AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **MEDIUM VOLTAGE** . . . . . V_{CEO} = -25 V
- **HIGH GAIN** . . . . . h_{FE} = 150 (MIN) AT 100 μA
  . . . . . h_{FE} = 300-600 AT 2.0 mA
- **COMPLEMENTARY TO MPS6520 • MPS6521**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55° C to +150° C
Operating Junction Temperature	-55° C to +150° C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25° C Case Temperature	1.0 W
Total Dissipation at 25° C Ambient Temperature	.625 W
at 70° C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	-25 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	-25 Volts
V_{EBO}	Emitter to Base Voltage	-4.0 Volts
I_C	Collector Current	100 mA

ELECTRICAL CHARACTERISTICS (25° C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS6522 MIN.	MPS6522 TYP.	MPS6522 MAX.	MPS6523 MIN.	MPS6523 TYP.	MPS6523 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	**Collector to Emitter Breakdown Voltage**	**-25**			**-25**			**Volts**	**I_C = 500 μA, I_B = 0**
BV_{EBO}	Emitter to Base Breakdown Voltage	-4.0			-4.0			Volts	I_E = 10 μA, I_C = 0
I_{CBO}	Collector Cutoff Current			50			50	nA	V_{CB} = -30 V, I_E = 0
$I_{CBO}(60°C)$	Collector Cutoff Current			1.0			1.0	μA	V_{CB} = -30 V, I_E = 0
h_{FE}	DC Current Gain	100			150				I_C = 100 μA, V_{CE} = -10 V
h_{FE}	**DC Current Gain**	**200**		**400**	**300**		**600**		**I_C = 2.0 mA, V_{CE} = -10 V**
$V_{CE}(sat)$	Collector Saturation Voltage			-0.5			-0.5	Volt	I_C = 50 mA, I_B = 5.0 mA
C_{obo}	Output Capacitance (f=100 kHz)			3.5			3.5	pF	V_{CB} = -10 V, I_E = 0
f_T	Current Gain Bandwidth Product (f = 100 MHz)		390			390		MHz	I_C = 2.0 mA, V_{CE} = -10 V
f_T	Current Gain Bandwidth Product (f = 100 MHz)		420			420		MHz	I_C = 10 mA, V_{CE} = -10 V
NF	Wideband Noise Figure (f = 10 Hz – 10 kHz)		1.8	3.0		1.8	3.0	dB	V_{CE} = -5 V, I_C = 10 μA, R_s = 10 kΩ Power Bandwidth 15.7 kHz

NOTES:

*Planar is a patented Fairchild process

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150° C and junction to case thermal resistance of 125° C/Watt (derating factor of 8.0 mW/° C); junction to ambient thermal resistance of 200° C/Watt (derating factor of 5.0 mW/° C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

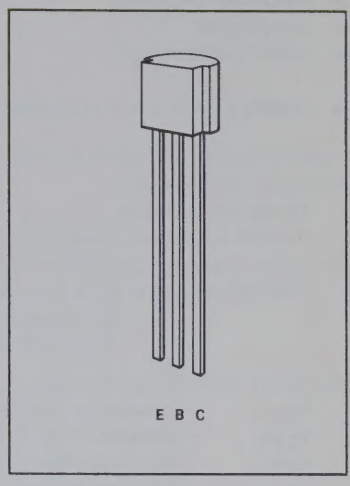
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS6530 • MPS6531 • MPS6532

NPN GENERAL PURPOSE AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **MEDIUM VOLTAGE** . . . . . V_{CEO} = 40 V (MIN)
- **HIGH GAIN** . . . . . h_{FE} = 90-270 AT 100 mA (MPS6531)
- **HIGH DISSIPATION** . . . . . P_D = 625 mW AT T_A = 25°C
  P_D = 400 mW AT T_A = 70°C
- **COMPLEMENTARY TO MPS6533M • MPS6534M • MPS6535M**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	+150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	0.625 W
at 70°C Ambient Temperature	0.400 W

Maximum Voltages and Currents

		MPS6530	MPS6531	MPS6532
V_{CBO}	Collector to case Voltage	60 V	60 V	50 V
V_{CEO}	Collector to Emitter Voltage (Note 4)	40 V	40 V	30 V
V_{EBO}	Emitter to Base Voltage	5.0 V	5.0 V	5.0 V
I_C	Collector Current	600 mA	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unl s otherwise noted)

SYMBOL	CHARACTERISTIC	MPS6530 MIN.	MPS6530 TYP.	MPS6530 MAX.	MPS6531 MIN.	MPS6531 TYP.	MPS6531 MAX.	MPS6532 MIN.	MPS6532 TYP.	MPS6532 MAX.	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	60			60			50			Volts	I_C = 10 μA, I_E = 0
BV_{CEO}	**Collector to Emitter Breakdown Voltage**	**40**			**40**			30			**Volts**	**I_C = 10 mA, I_B = 0**
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0			5.0			5.0			Volts	I_B = 10 μA, I_C = 0
I_{CBO}	Collector Cutoff Current			50			50				nA	V_{CB} = 40 V, I_E = 0
I_{CBO}	Collector Cutoff Current									100	nA	V_{CB} = 30 V, I_E = 0
I_{CBO}(60°C)	Collector Cutoff Current			2.0			2.0				μA	V_{CB} = 40 V, I_E = 0
I_{CBO}(60°C)	Collector Cutoff Current									5.0	μA	V_{CB} = 30 V, I_E = 0
h_{FE}	DC Current Gain (Note 5)	30	75		60	120						I_C = 10 mA, V_{CE} = 1.0 V
h_{FE}	**DC Current Gain (Note 5)**	40	85	120	**90**	**150**	**270**	30				**I_C = 100 mA, V_{CE} = 1.0 V**
h_{FE}	DC Current Gain (Note 5)	25	60		50	80						I_C = 500 mA, V_{CE} = 10 V
$V_{CE(sat)}$	Collector Saturation Voltage (Note 5)		0.2	0.5		0.13	0.3		0.2	0.5	Volt	I_C = 100 mA, I_B = 10 mA
$V_{BE(sat)}$	Base Saturation Voltage (Note 5)		0.82	1.0		0.82	1.0		0.85	1.2	Volts	I_C = 100 mA, I_B = 10 mA
C_{ob}	Output Capacitance (f=100 kHz)		3.5	5.0		3.5	5.0		3.5	5.0	pF	V_{CB} = 10 V, I_E = 0
f_T	Current Gain Bandwidth Product (f = 100 MHz)		390			390			390		MHz	I_C = 50 mA, V_{CE} = 10 V

*Planar is a patented Fairchild process

NOTES

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

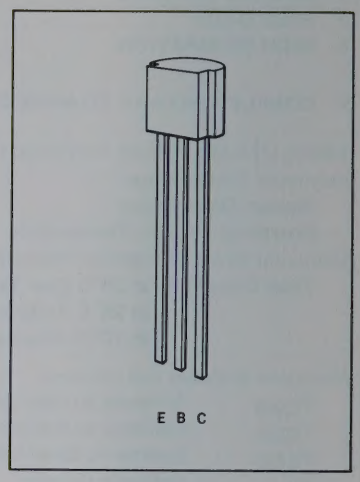
(5) Pulse conditons: length = 300 μs; duty cycle = 2%.

MPS6533M • MPS6534M • MPS6535M

PNP GENERAL PURPOSE AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **MEDIUM VOLTAGE** . . . . . $V_{CEO} = -40$ V (MIN)
- **HIGH GAIN** . . . . . h_{FE} = 90-270 AT 100 mA (MPS6534M)
- **HIGH DISSIPATION** . . . . . P_D = 625 mW AT $T_A = 25°C$
  P_D = 400 mW AT $T_A = 70°C$
- **COMPLEMENTARY TO MPS6530 • MPS6531 • MPS6532**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55° C to + 150° C
Operating Junction Temperature	+ 150° C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25° C Case Temperature	1.0 W
25° C Ambient Temperature	0.625 W
70° C Ambient Temperature	0.400 W

Maximum Voltages and Currents

		MPS6533M	MPS6534M	MPS6535M
V_{CBO}	Collector to Case Voltage	−40 V	−40V	−30 V
V_{CEO}	Collector to Emitter Voltages (Note 4)	−40 V	−40 V	−30 V
V_{EBO}	Emitter to Base Voltage	−4.0 V	−4.0 V	−4.0 V
I_C	Collector Current	600 mA	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25° C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS6533M MIN	MPS6533M TYP	MPS6533M MAX	MPS6534M MIN	MPS6534M TYP	MPS6534M MAX	MPS6535M MIN	MPS6535M TYP	MPS6535M MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage	−40			−40			−30			Volts	I_C=10μA, I_E = 0
BV_{CEO}	Collector to Emitter Breakdown Voltage	−40			−40			−30			Volts	I_C=10 mA, I_B = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	−4.0			−4.0			−4.0			Volts	I_B=10 μA, I_C = 0
I_{CBO}	Collector Cutoff Current			50			50				nA	V_{CB}=-30 V, I_E = 0
I_{CBO}	Collector Cutoff Current									100	nA	V_{CB}=-20 V, I_E = 0
I_{CBO}(60° C)	Collector Cutoff Current			2.0			2.0				μA	V_{CB}=-30 V, I_E = 0
I_{CBO}(60° C)	Collector Cutoff Current									5.0	μA	V_{CB}=-20 V, I_E = 0
h_{FE}	DC Current Gain (Note 5)	30	75		60	120						I_C = 10 mA, V_{CE}=-1.0V
h_{FE}	DC Current Gain (Note 5)	40	85	120	90	150	270	30				I_C = 100mA, V_{CE}=-1.0V
h_{FE}	DC Current Gain (Note 5)	25	60		50	80						I_C = 500mA, V_{CE}=-10 V
V_{CE}(sat)	Collector Saturation Voltage (Note 5)		−0.2	−0.5		−0.13	−0.3		−0.2	−0.5	Volt	I_C = 100mA, I_B= 10 mA
V_{BE}(sat)	Base Saturation Voltage (Note 5)		−0.82	−1.0		−0.82	−1.0		−0.85	−1.2	Volts	I_C = 100mA, I_B=10 mA
C_{ob}	Output Capacitance (f=100kHz)			8.0			8.0			8.0	pF	V_{CB} = -10 V, I_E = 0
f_t	Current Gain Bandwidth Product(f=100 MHz)		260			260			260		MHz	I_C = 50 mA, V_{CE} = −10 V

NOTES:

*Planar is a patented Fairchild process

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150° C and junction to case thermal resistance of 125° C Watt (derating factor of 8.0 mW/° C); junction to ambient thermal resistance of 200° C/watt (derating factor of 5.0 mW/° C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

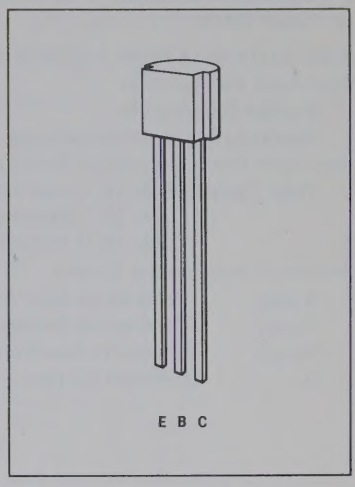
(5) Pulse conditions: length = 300 μs; duty cycle = 2%.

MPS6560 • MPS6561 • MPS6562 • MPS6563

NPN-PNP GENERAL PURPOSE COMPLEMENTARY AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **MEDIUM VOLTAGE . . . . . V_{CEO} = 25 V (MIN)**
- **MEDIUM FREQUENCY . . . . . f_T = 60 MHz (MIN) AT 10 mA**
- **LOW SATURATION VOLTAGE . . . . V_{CE}(sat) = 0.5 V (MAX) AT 500 mA**
- **COMPLEMENTARY DEVICES MPS6560, MPS6561 (NPN) • MPS6562, MPS6563 (PNP)**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

		MPS6560	MPS6561	MPS6562	MPS6563
V_{CBO}	Collector to Base Voltage	25 Volts	20 Volts	−25 Volts	−20 Volts
V_{CEO}	**Collector to Emitter Voltage** (Note 4)	**25 Volts**	20 Volts	**−25 Volts**	−20 Volts
V_{EBO}	Emitter to Base Voltage	5.0 Volts	5.0 Volts	−5.0 Volts	−5.0 Volts
I_C	Collector Current	600 mA	600 mA	600 mA	600 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS6560•MPS6562 MIN.	MPS6560•MPS6562 MAX.	MPS6561•MPS6563 MIN.	MPS6561•MPS6563 MAX.	UNITS	TEST CONDITIONS (Reverse Voltage Polarity For PNP)	
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		5.0		Volts	I_E = 100 μA,	I_C = 0
I_{CEO}	Collector Cutoff Current		100			nA	V_{CE} = 25 V,	I_B = 0
I_{CEO}	Collector Cutoff Current				100	nA	V_{CE} = 20 V,	I_B = 0
I_{CBO}	Collector Cutoff Current		100		100	nA	V_{CB} = 20 V,	I_E = 0
I_{EBO}	Emitter Cutoff Current		100		100	nA	V_{EB} = 4.0 V,	I_C = 0
h_{FE}	DC Current Gain	35		35			I_C = 10 mA,	V_{CE} = 1.0 V
h_{FE}	DC Current Gain	50		50			I_C = 100 mA,	V_{CE} = 1.0 V
h_{FE}	DC Current Gain			50	200		I_C = 350 mA,	V_{CE} = 1.0 V
h_{FE}	DC Current Gain	50	200				I_C = 500 mA,	V_{CE} = 1.0 V
$V_{CE(sat)}$	Collector Saturation Voltage		0.5			Volt	I_C = 500 mA,	I_B = 50 mA
$V_{CE(sat)}$	**Collector Saturation Voltage**				**0.5**	**Volt**	**I_C = 350 mA,**	**I_B = 35 mA**
V_{BE}(on)	Base to Emitter On Voltage		1.2			Volts	I_C = 500 mA,	V_{CE} = 1.0 V
V_{BE}(on)	Base to Emitter On Voltage				1.2	Volts	I_C = 350 mA,	V_{CE} = 1.0 V
f_T	**Current Gain Bandwidth Product (f = 30 MHz)**	60		**60**		**MHz**	**I_C = 10 mA,**	**V_{CE} = 10 V**
C_{obo}	Output Capacitance (f = 100 kHz)		30		30	pF	V_{CB} = 10 V,	I_E = 0

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low cuty cycle operations

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

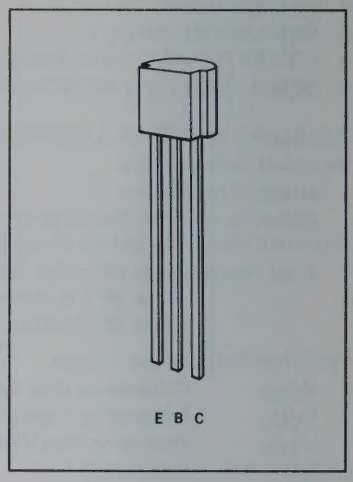
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS6565 • MPS6566

NPN GENERAL PURPOSE AMPLIFIERS

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **MEDIUM VOLTAGE . . . . . BV_{CEO} = 45 V (MIN)**
- **HIGH GAIN . . . . . h_{FE} = 100-400 AT 10 mA**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	45 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts
I_C	Collector Current	200 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS6565 MIN.	MPS6565 TYP.	MPS6565 MAX.	MPS6566 MIN.	MPS6566 TYP.	MPS6566 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	**Collector to Emitter Breakdown Voltage**	**45**			**45**			**Volts**	**I_C = 1.0 mA, I_B = 0**
BV_{CBO}	Collector to Base Breakdown Voltage	60			60			Volts	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			4.0			Volts	I_E = 100 μA, I_C = 0
I_{CBO}	Collector Cutoff Current			100			100	nA	V_{CB} = 30 V, I_E = 0
h_{FE}	**DC Current Gain**	40		160	**100**		**400**		**I_C = 10 mA, V_{CE} = 10 V**
$V_{CE}(sat)$	Collector Saturation Voltage		0.1	0.4		0.1	0.4	Volt	I_C = 10 mA, I_B = 1.0 mA
C_{obo}	Output Capacitance (f=100 kHz)			3.5			3.5	pF	V_{CB} = 10 V, I_E = 0
C_{ibo}	Input Capacitance (f=100 kHz)		3.7			3.7		pF	V_{EB} = 0.5 V, I_C = 0
h_{fe}	High Frequency Current Gain (f = 100 MHz)	2.0			2.0				I_C = 10 mA, V_{CE} = 10 V
h_{oe}	Output Admittance (f=1.0 kHz)		60			60		μMhos	I_C = 10 mA, V_{CE} = 10 V
h_{ie}	Input Impedance (f=1.0 kHz)		500			500		Ω	I_C = 10 mA, V_{CE} = 10 V
h_{re}	Voltage Feedback Ratio (f=1.0 kHz)		2.5			2.5		$X10^{-4}$	I_C = 10 mA, V_{CE} = 10 V
NF	Noise Figure (f=10 Hz to 15.7 kHz)		4.0			4.0		dB	I_C = 100 μA, V_{CE} = 5.0 V, R_S = 1.0 kΩ

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of °C and junction to case thermal resistance of °C/Watt (derating factor of mw/°C); junction to ambient thermal resistance of °C/Watt (derating factor of mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

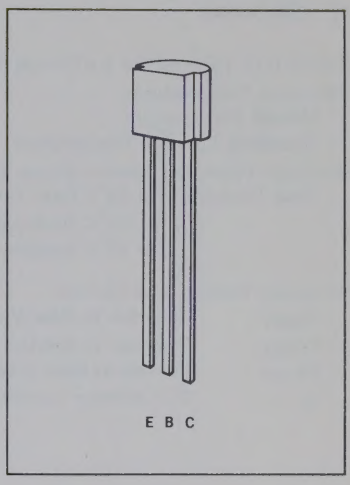
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS6571

NPN AUDIO PREAMPLIFIER

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- V_{CEO} . . . . . 20 V (MIN)
- h_{FE} . . . . . 250-1000 AT 100 μA



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	-55°C to +150°C
Operating Junction Temperature	-55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
Total Dissipation at 25°C Ambient Temperature	0.625 W
at 70°C Ambient Temperature	0.400 W

Maximum Voltages and Current

V_{CBO}	Collector to Base Voltage	20 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	20 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts
I_C	Collector Current	50 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	**Collector to Emitter Breakdown Voltage**	**20**			**Volts**	**I_C = 1.0 mA, I_B = 0**
BV_{CBO}	Collector to Base Breakdown Voltage	25			Volts	I_C = 100 μA, I_E = 0
I_{CBO}	Collector Cutoff Current			50	nA	V_{CB} = 20 V, I_E = 0
I_{EBO}	Emitter Cutoff Current			50	nA	V_{EB} = 3.0 V, I_C = 0
h_{FE}	**DC Current Gain**	**250**		**1000**		**I_C = 100 μA, V_{CE} = 5.0 V**
$V_{CE}(sat)$	Collector Saturation Voltage			0.5	Volt	I_C = 10 mA, I_B = 1.0 mA
$V_{BE}(on)$	Base to Emitter On Voltage			0.8	Volt	I_C = 10 mA, V_{CE} = 5.0 V
f_T	Current Gain Bandwidth Product (f = 20 MHz)	50	175		MHz	I_C = 500 μA, V_{CE} = 5.0 V
C_{obo}	Output Capacitance (f = 100 kHz)			4.5	pF	V_{CB} = 5.0 V, I_E = 0
NF	Noise Figure (f = 100 Hz)		1.2		dB	I_C = 100 μA, V_{CE} = 5.0 V, R_s = 10 kΩ

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mw/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

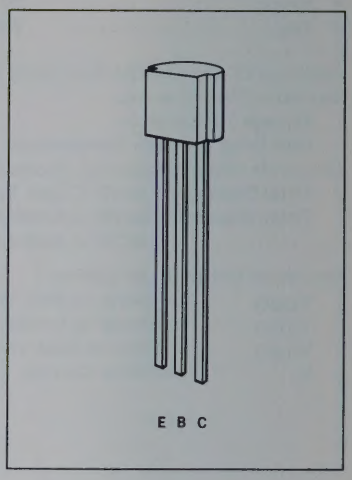
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MPS6590 • MPS6591

NPN AMPLIFIER

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTORS

- **HIGH VOLTAGE . . . . . BV_{CEO} = 80 V (MIN) MPS6590**
- **LOW NOISE . . . . . NF = 3.0 dB (TYP) WIDEBAND**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages and Current

		MPS6590	MPS6591
V_{CBO}	Collector to Base Voltage	100 Volts	60 Volts
V_{CEO}	Collector to Emitter Voltage (Note 4)	80 Volts	50 Volts
V_{EBO}	Emitter to Base Voltage	4.0 Volts	4.0 Volts
I_C	DC Collector Current	250 mA	250 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MPS6590 MIN.	MPS6590 TYP.	MPS6590 MAX.	MPS6591 MIN.	MPS6591 TYP.	MPS6591 MAX.	UNITS	TEST CONDITIONS
BV_{CEO}	**Collector to Emitter Breakdown Voltage**	**80**			**50**			**Volts**	**I_C = 1.0 mA, I_B = 0**
BV_{CBO}	Collector to Base Breakdown Voltage	100			60			Volts	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	4.0			4.0			Volts	I_E = 100 μA, I_C = 0
I_{CBO}	Collector Cutoff Current			100				nA	V_{CB} = 50 V, I_E = 0
I_{CBO}	Collector Cutoff Current						100	nA	V_{CB} = 30 V, I_E = 0
h_{FE}	**DC Current Gain**	**40**			**40**				**I_C = 10 mA, V_{CE} = 10 V**
$V_{CE(sat)}$	Collector Saturation Voltage			0.6			0.6	Volt	I_C = 10 mA, I_B = 1.0 mA
C_{cb}	Collector to Base Capacitance (f = 100 kHz)			12			12	pF	V_{CB} = 10 V, I_E = 0
C_{eb}	Emitter to Base Capacitance (f = 100 kHz)			50			50	pF	V_{BE} = 0.5 V, I_C = 0
h_{ie}	Input Impedance (f = 1.0 kHz)		1.4			1.4		kΩ	I_C = 10 mA, V_{CE} = 5.0 V
h_{re}	Voltage Feedback Ratio (f = 1.0 kHz)		0.8			0.8		X10^{-4}	I_C = 10 mA, V_{CE} = 5.0 V
h_{fe}	Small Signal Current Gain (f=30 MHz)	2.0			2.0				I_C = 10 mA, V_{CE} = 10 V
h_{oe}	Output Admittance (f = 1.0 kHz)		75			75		μmhos	I_C = 10 mA, V_{CE} = 5.0 V
NF	Noise Figure (f = 10 Hz to 15.7 kHz)		3.0			3.0		dB	I_C = 100 μA, V_{CE} = 5.0 V, R_S = 4 kΩ

*Planar is a patented Fairchild process

NOTES:

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

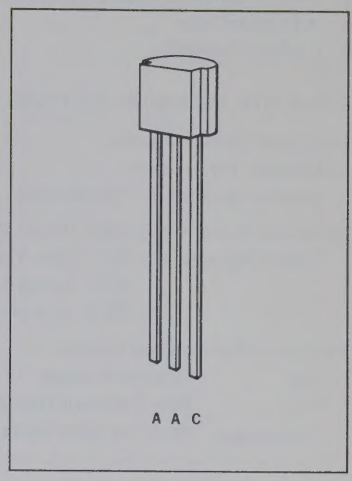
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

MSD6101 · MSD6102

DUAL DISCRIMINATOR AND HORIZONTAL PHASE DETECTOR DIODES

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL DIODES

- SPACE SAVING MONOLITHIC COMMON CATHODE CONFIGURATION
- FORWARD VOLTAGE MATCH . . . . . ΔV_F = 3mV (MAX) AT 100μA
- BREAKDOWN . . . . . BV = 50V OR 70V (MIN)



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55° C to + 150° C
Operating Junction Temperature	−55° C to + 150° C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25° C Case Temperature	1.0 W
25° C Ambient Temperature	0.625 W
70° C Ambient Temperature	0.400 W

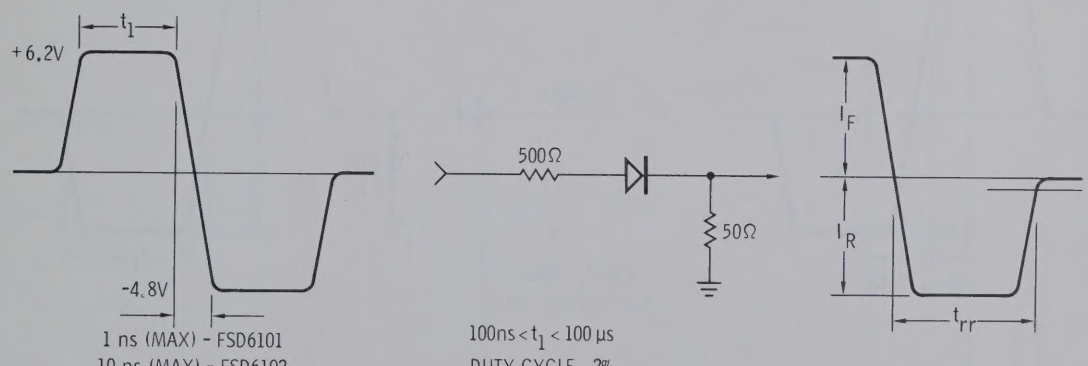
Maximum Voltages and Current

		MSD6101	MSD6102
V_R	Reverse Voltage	50 Volts	70 Volts
I_F	Peak Forward Recurrent Current	200 mA	200 mA
$I_{FM(surge)}$	Peak Forward Surge Current (PW = 10μs)	500 mA	500 mA

ELECTRICAL CHARACTERISTICS (25° C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MSD6101 MIN.	MSD6101 MAX.	MSD6102 MIN.	MSD6102 MAX.	UNITS	TEST CONDITIONS
$V_{(BR)}$	Breakdown Voltage	50		70		Volts	$I_{(BR)}$ = 100μA
I_R	Reverse Current		100			nA	V_R = 40V
I_R	Reverse Current				100	nA	V_R = 50V
$I_{R(125°C)}$	Reverse Current		100			μA	V_R = 40V
$I_{R(125°C)}$	Reverse Current				100	μA	V_R = 50V
V_F	Forward Voltage	0.43	0.57			Volt	I_F = 100μA
V_F	Forward Voltage	0.67	0.82	0.67	1.0	Volt	I_F = 10mA
C	Capacitance		2.0		3.0	pF	V_R = 0
t_{rr}	Reverse Recovery Time (Figure 1)		1.0		100	ns	I_F = I_R = 10mA
V_{F1}-V_{F2}	Forward Voltage Matching		0.003			Volt	I_{F1} = I_{F2} = 100μA

FIGURE 1. – RECOVERY TIME EQUIVALENT TEST CIRCUIT



†JEDEC Registered Values

*Planar is a patented Fairchild process

NOTES:

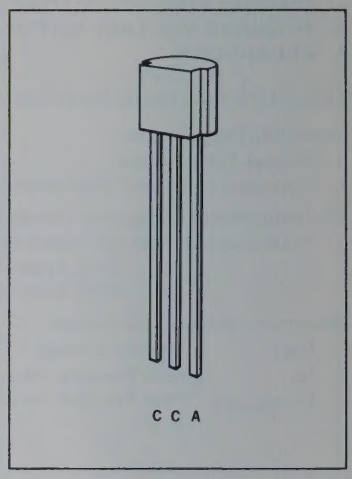
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0mW/°C); junction to ambient thermal resistance of 200° C/Watt (derating factor of 5.0mW/° C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse conditions: length = 300μs; duty cycle = 1%

MSD6150

GENERAL PURPOSE DUAL DIODE

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL DIODE

- SPACE SAVING MONOLITHIC COMMON ANODE CONFIGURATION
- BREAKDOWN . . . . . BV = 70 V (MIN)
- CAPACITANCE . . . . . C = 3.5pF (MAX)



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
25°C Ambient Temperature	0.625 W
70°C Ambient Temperature	0.400 W

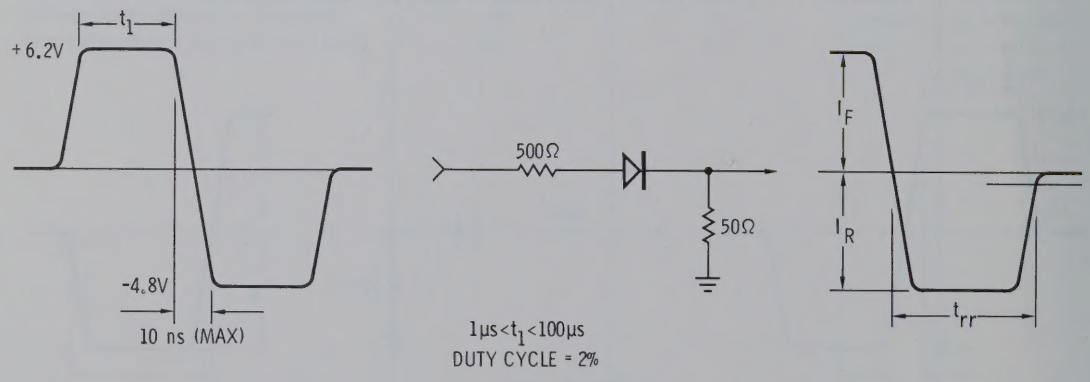
Maximum Voltages and Current

V_R	Reverse Voltage	70 Volts
I_F	Peak Forward Recurrent Current	200 mA
$I_{FM(surge)}$	Peak Forward Surge Current (PW = 10μs)	500 mA

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN	TYP.	MAX.	UNITS	TEST CONDITIONS
$V_{(BR)}$	Breakdown Voltage	70			Volts	$I_{(BR)}$ = 100μA
I_R	Reverse Current			100	nA	V_R = 50 V
V_F	Forward Voltage		0.8	1.0	Volt	I_F = 10mA
C	Capacitance		5.0	8.0	pF	V_R = 0
t_{rr}	Reverse Recovery Time (Figure 1)			100	ns	$I_F = I_R$ = 10mA, t_{rr} = 1.0mA

FIGURE 1. – RECOVERY TIME EQUIVALENT TEST CIRCUIT



*Planar is a patented Fairchild process

NOTES:

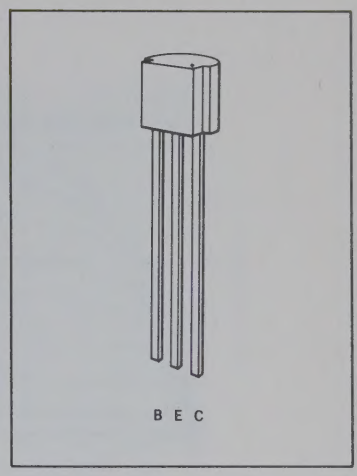
(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0mW/°C).
(4) Rating refers to a high current point where collector to emitter voltage is lowest.
(5) Pulse conditions: length = 300μs; duty cycle = 1%.

PE5010

NPN RF-AGE AMPLIFIER

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **HIGH POWER GAIN . . . . . 20 dB (MIN) @ 200 MHz**
- **LOW NOISE FIGURE . . . . . 3.3 dB (MAX) @ 200 MHz**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	−55°C to +150°C
Operating Junction Temperature	−55°C to +150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
at 25°C Ambient Temperature	.625 W
at 70°C Ambient Temperature	.400 W

Maximum Voltages

V_{CBO}	Collector to Base Voltage	30 Volts
V_{CEO}	Collector to Emitter Voltage (Note 3)	30 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
NF	**Noise Figure (f = 200 MHz)**		**2.8**	**3.3**	**dB**	**V_{CC} = 12 V, (Note 5)**
PG	**Power Gain (f = 200 MHz)**	**20**	**25**	**27**	**dB**	**V_{AGC} = 1.4V, See Figure 1**
$V_{AGC(30)}$	**AGC Voltage for 30 dB Gain Reduction (f = 200 MHz)**	**4.0**	**4.5**	**5.0**	**Volts**	**V_{CC} = 12 V, See Figure 1**
h_{FE}	DC Pulse Current Gain (Note 4)	25	75	200		I_C = 4.0 mA, V_{CE} = 5.0V
C_{cb}	Collector to Base Capacitance (f = 1.0 MHz)	0.25	0.37	0.5	pF	I_E = 0, V_{CB} = 10 V
I_{CBO}	Collector Cutoff Current			50	nA	I_E = 0, V_{CB} = 10 V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 3 and 4)	30			Volts	I_C = 1.0 mA, I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	30			Volts	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	I_C = 0, I_E = 100 μA
$V_{CE(sat)}$	Collector Saturation Voltage			3.0	Volts	I_C = 10 mA, I_B = 5.0mA
$V_{BE(sat)}$	Base Saturation Voltage			0.95	Volt	I_C = 10 mA, I_B = 5.0mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.75	5.0			I_C = 4.0 mA, V_{CE} = 10V

*Planar is a patented Fairchild process

NOTES

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be imparied.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

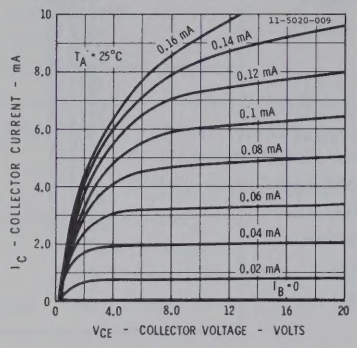
(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

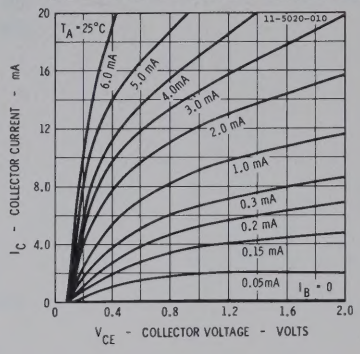
(5) Pulse conditions: length = 300 μs; duty cycle = 1%.

TYPICAL ELECTRICAL CHARACTERISTICS

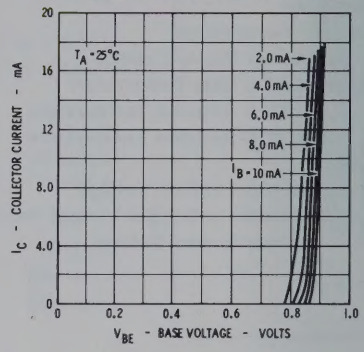
COLLECTOR CHARACTERISTICS



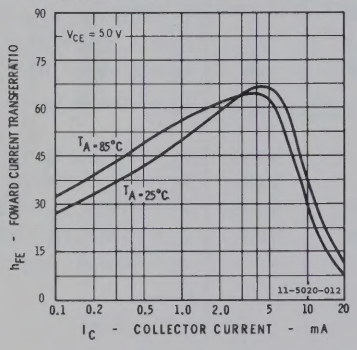
COLLECTOR CHARACTERISTICS



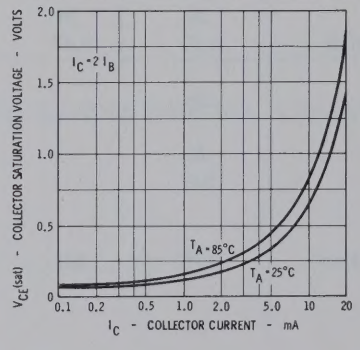
BASE CHARACTERISTICS



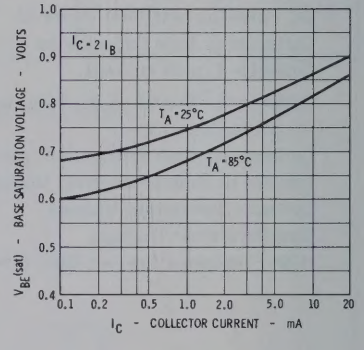
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



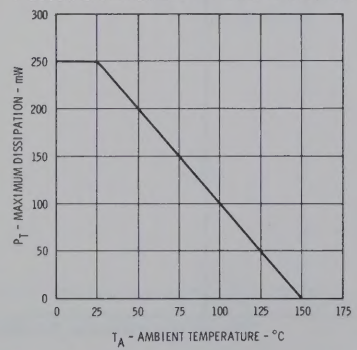
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



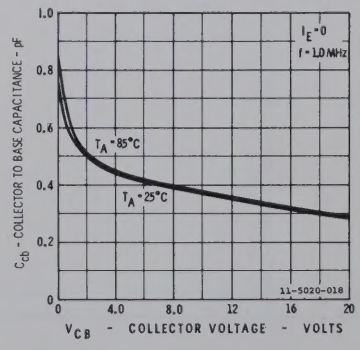
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



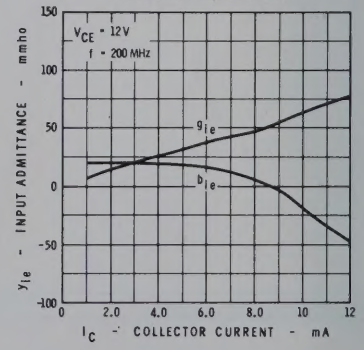
MAXIMUM POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



COMMON EMITTER FEEDBACK CAPACITY VERSUS COLLECTOR VOLTAGE

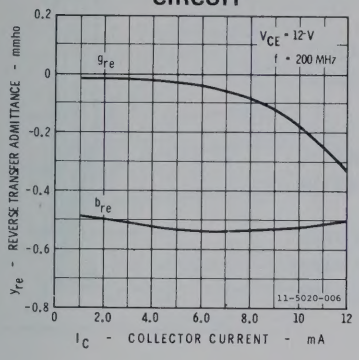


INPUT ADMITTANCE VERSUS COLLECTOR CURRENT — OUTPUT SHORT CIRCUIT

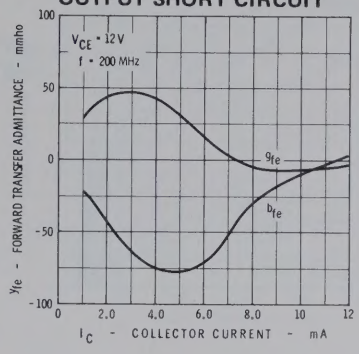


TYPICAL ELECTRICAL CHARACTERISTICS

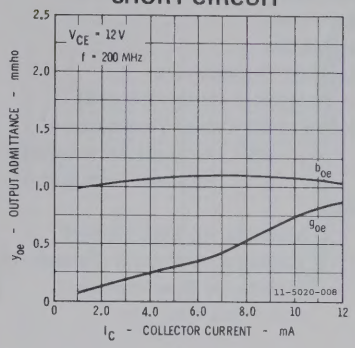
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT – INPUT SHORT CIRCUIT



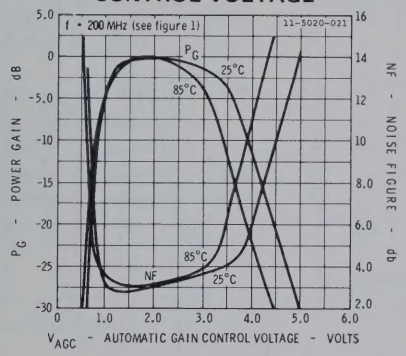
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT OUTPUT SHORT CIRCUIT



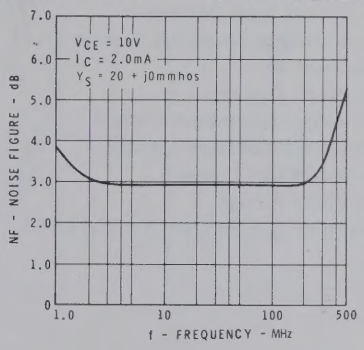
OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT – INPUT SHORT CIRCUIT



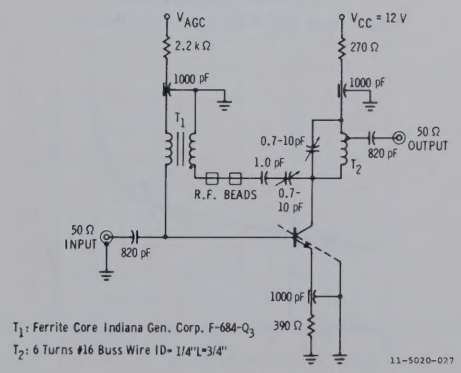
POWER GAIN AND NOISE FIGURE VERSUS AUTOMATIC GAIN CONTROL VOLTAGE



NOISE FIGURE VERSUS FREQUENCY



200 MHz AGC, POWER GAIN AND NOISE FIGURE TEST JIG

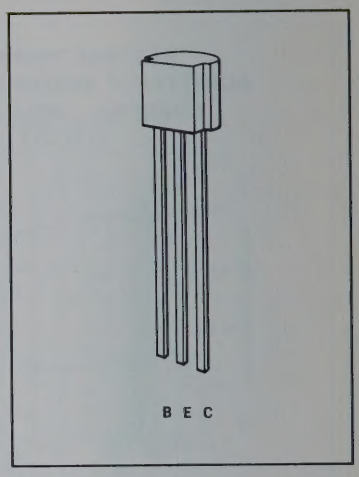


PE5015

NPN RF-AGC AMPLIFIER

FAIRCHILD DIFFUSED SILICON PLANAR* EPITAXIAL TRANSISTOR

- **LOW FEEDBACK (C_{cb}) . . . . . 0.25 - 0.50 pF (GUARANTEED MIN. AND MAX.)**
- **LOW NOISE FIGURE . . . . . 4 dB (MAX.) AT 100 MHz**
- **HIGH POWER GAIN . . . . . 20 dB (MIN.) AT 100 MHz**
- **FORWARD AGC CAPABILITY**



ABSOLUTE MAXIMUM RATINGS (Note 1)

Maximum Temperatures

Storage Temperature	–55°C to + 150°C
Operating Junction Temperature	–55°C to + 150°C

Maximum Power Dissipation (Notes 2 and 3)

Total Dissipation at 25°C Case Temperature	1.0 W
25°C Ambient Temperature	.625 W
70°C Ambient Temperature	.400 W

Maximum Voltages

V_{CBO}	Collector to Base Voltage	20 Volts
V_{CEO}	Collector to Emitter Voltage (Note 3)	20 Volts
V_{EBO}	Emitter to Base Voltage	3.0 Volts

ELECTRICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise noted)

SYMBOL	CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
NF	**Noise Figure (f = 100 MHz)**		**3.0**	**4.0**	**dB**	**V_{AGC}= 2.0V, V_{CC}=12 V**
PG	**Power Gain (f = 100 MHz) (Notes 5 and 6)**	**20**	**27.5**		**dB**	**See Figure 1**
$V_{AGC(30)}$	AGC Voltage for 30 dB Gain Reduction (f = 100 MHz)		4.7		Volts	V_{CC}=12 V, See Figure 1
C_{cb}	**Collector to Base Capacitance (f = 1.0 MHz)**	**0.25**	**0.37**	**0.50**	**pF**	**I_E = 0, V_{CB} = 10 V**
h_{FE}	DC Pulse Current Gain (Note 4)	20	50	200		V_{CE} = 5.0 V, I_C = 4.0mA
$V_{CEO(sat)}$	**Collector to Emitter Sustaining Voltage (Notes 3 and 4)**	**20**			**Volts**	**I_C = 1.0 mA, I_B = 0**
I_{CBO}	Collector Cutoff Current			50	nA	I_E = 0, V_{CB} = 10 V
BV_{CBO}	Collector to Base Breakdown Voltage	20			Volts	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	3.0			Volts	I_C = 0, I_E = 100 μA
$V_{CE(sat)}$	Collector Saturation Voltage			3.0	Volts	I_C = 10 mA, I_B = 5.0mA
$V_{BE(sat)}$	Base Saturation Voltage			0.95	Volt	I_C = 10 mA, I_B =5.0mA
h_{fe}	High Frequency Current Gain (f = 100 MHz)	3.0	4.5			I_C = 4.0 mA, V_{CE}=10V

*Planar is a patented Fairchild process

NOTES

(1) These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.

(2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.

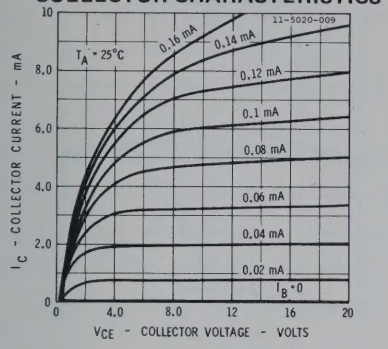
(3) These ratings give a maximum junction temperature of 150°C and junction to case thermal resistance of 125°C/Watt (derating factor of 8.0 mW/°C); junction to ambient thermal resistance of 200°C/Watt (derating factor of 5.0 mW/°C).

(4) Rating refers to a high current point where collector to emitter voltage is lowest.

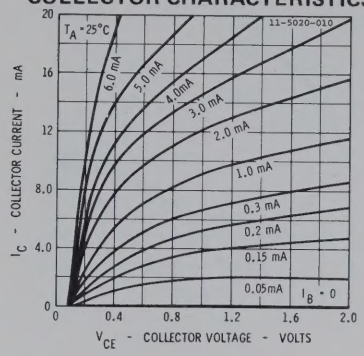
(5) Pulse conditions length = 300 μs; duty cycle = 1%.

TYPICAL ELECTRICAL CHARACTERISTICS

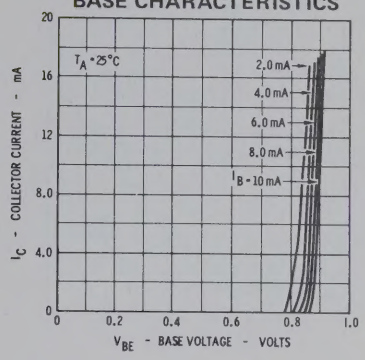
COLLECTOR CHARACTERISTICS



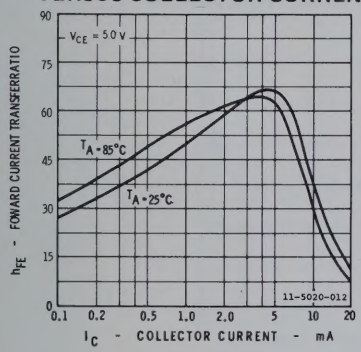
COLLECTOR CHARACTERISTICS



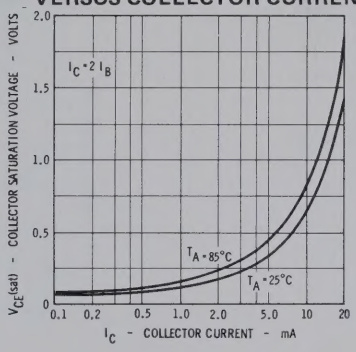
BASE CHARACTERISTICS



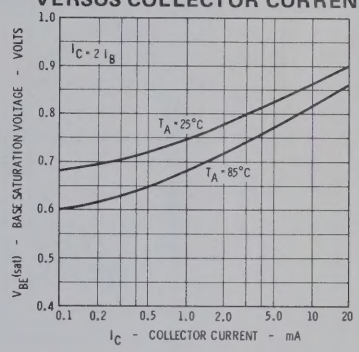
PULSED DC CURRENT GAIN VERSUS COLLECTOR CURRENT



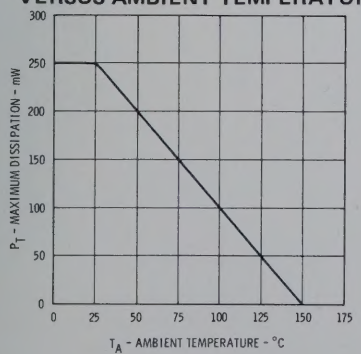
COLLECTOR SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



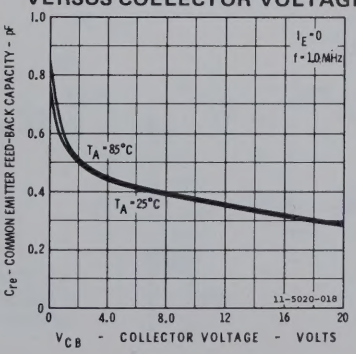
BASE SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



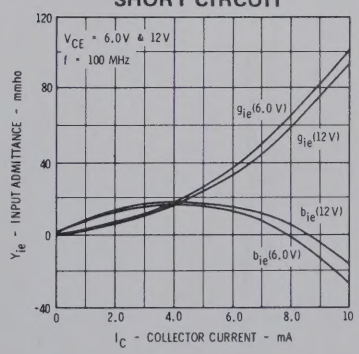
MAXIMUM POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



COMMON EMITTER FEED-BACK CAPACITY VERSUS COLLECTOR VOLTAGE

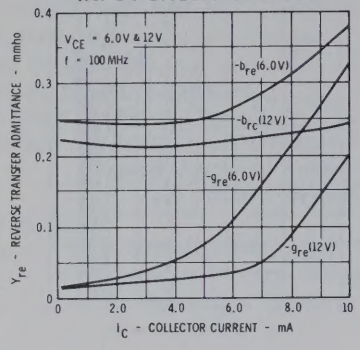


INPUT ADMITTANCE VERSUS COLLECTOR CURRENT – OUTPUT SHORT CIRCUIT

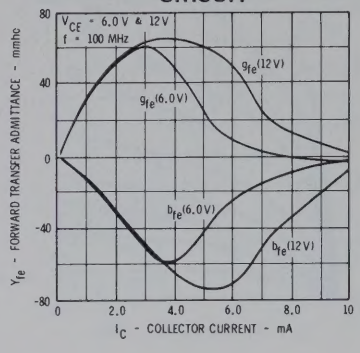


TYPICAL ELECTRICAL CHARACTERISTICS

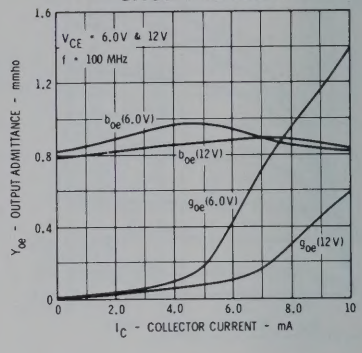
REVERSE TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT – INPUT SHORT CIRCUIT



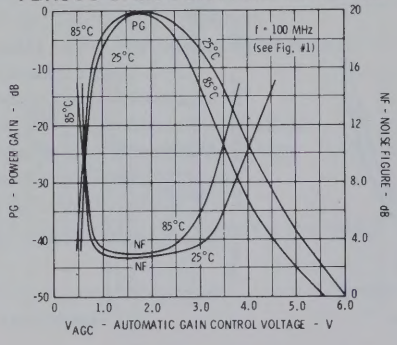
FORWARD TRANSFER ADMITTANCE VERSUS COLLECTOR CURRENT – OUTPUT SHORT CIRCUIT



OUTPUT ADMITTANCE VERSUS COLLECTOR CURRENT – INPUT SHORT CIRCUIT



POWER GAIN AND NOISE FIGURE VERSUS GAIN CONTROL VOLTAGE



NOISE FIGURE VERSUS FREQUENCY

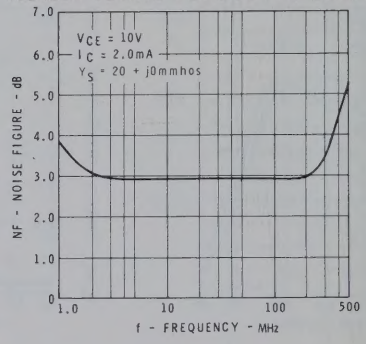
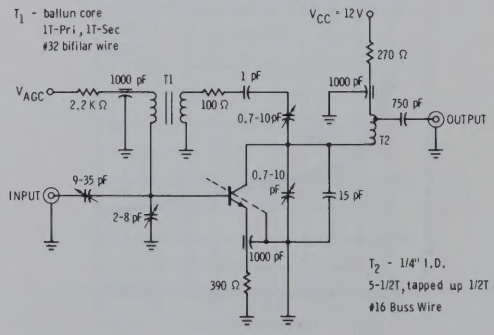


FIG. 1 – 100 MHz AGC, POWER GAIN, AND NOISE FIGURE TEST JIG



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Printed in U.S.A./07-10-0187-120/25M